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MISSISSIPPI

Agricultural Experiment Station,

BULLETIN NO. 1.

MARCH, 21ST 1888.

ORGANIZATION.

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ANNOUNCEMENT:

By an Act of Congress approved March 2d, 1887, provision was made for the establishment of an Agricultural Experiment Station in each State and Territory, and on January 30th, 1888, an additional Act was passed providing funds for the necessary expenses of the Stations. On January 27th, 1888, the State Legislature of Mississippi accepted this grant on behalf of the State, and located the Mississippi Station at the Agricultural College, and placed its management in the hands of the Board of Trustees of the College.

As soon as possible after the funds became available, the Board of Trustees held a meeting and organized the Station for work by the appointment of the necessary assistants and adopting a program for the work of the present year. The immediate control of the Station was placed in the hands of a Governing Board composed of the President of the Agricultural College, Gen. S. D. Lee, the local member of the Board of Trustees, Hon. W. B. Montgomery, and the Director of the Station, S. M. Tracy. The President of the State Farmers' Alliance, the Master of the State Grange, the President of the State Horticultural Society and the Chief officer of any other State organization having for its main object the improvement of the agriculturul resources of the State, or the improvement of live-stock, were made an Advisory Board.

The Act of Congress making provision for the establishment of the Station says:

"SEC. 2. That it shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the

agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories."

It will be seen from the above that the funds of the Station cannot be used for defraying any College expenses, or to aid the College in any way, except so far as it may do so by relieving it from outlay for experiment work. The work of the Station must be confined to experimentation alone, and cannot be used for teaching.

It is the intention of the Governing Board to make the work of the Station entirely practical, so as to bring its results within the reach of every farmer in the State. Special attention will be given to ascertaining the best methods for restoring fertility to exhausted soils, to the comparative advantages of different crop rotations, to improved dairy methods, to the value of new varieties of plants for cultivation in this climate, to the introduction of new species of grasses and forage plants and to the best methods for destroying injurious insects and fungi. Specimens of plants or insects for identification, samples of agricultural products, plants showing the effects of disease, and any other objects of general interest may be sent to the Station for examination. Such articles intended for examination should be plainly marked with the name and address of the sender, and be sent, EXPRESS CHARGES PREPAID, to

DIRECTOR OF EXPERIMENT STATION,
Starkville, Miss.

Letters and mail packages should be addressed to

DIRECTOR OF EXPERIMENT STATION,
Agricultural College, Miss.

From the fact that the Congressional appropriation was not received until too late in the season for completing certain lines of work which it is desirable that the Station should undertake, the work of the present year will be largely preparatory for the more extended experiments which will be attempted in the future.

Bulletins or reports of work done at the Station will be published at least once in three months, and at the end of each year a full annual report will be issued. These bulletins and reports will be mailed free to all residents of the State who apply for them, and who are actually engaged in farming, as far as the means of the Station will permit.

Correspondence in regard to agricultural matters is desired, and all letters of inquiry will receive prompt attention.

S. M. TRACY, Director.

Agricultural College, Miss., March 21, 1888.

MISSISSIPPI A. & M. COLLEGE

Agricultural Extension Department

E. R. LLOYD, Director.

AGRICULTURAL COLLEGE, MISSISSIPPI.

BULLETIN No. 2.

Dairy Barn Construction

EXTERIOR VIEW OF DAIRY BARN IN MISSISSIPPI
CAPACITY 26 COWS, COST $685.00

By L. A. HIGGINS.

Dairy Extension Department, Cooperating with Dairy Division, Bureau of Animal Industry, U. S. Department Of Agriculture.

and

D. SCOATES.

Agricultural Engineering Department.

TUCKER PRINTING HOUSE, JACKSON, MISS.

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INTRODUCTION

Although dairying has made a wonderful growth in Mississippi the last few years, the industry is still in its infancy. It is, therefore, highly important that a good, substantial foundation be established upon which to build in future years. Every building erected on a farm should be for a definite purpose and so planned as best to meet the needs of that purpose. In the past the average farmer in Mississippi has put little time and thought into the question of proper housing and care of his farm animals, especially of the family cow. The mild open winters have instilled the idea that the storage of feed for winter feeding and the provision of shelter are not absolute essentials in this State. But with the growth of the dairy industry the farmers are fast realizing the fact that for an animal to be a profitable producer she must be well fed during the entire year and must be kept comfortable. These conditions can be maintained only when provision is made for storage of hay and grain and when the cows are sheltered from the winter winds and rains.

The consuming public is rapidly becoming educated to the point where it will demand that the dairy products be produced under sanitary conditions. Standards are being constantly raised, making it necessary for barns to be built so that they can be kept clean. Almost weekly, in travels over the State, one finds some farmer who has gone to the expense of erecting a dairy barn or milking shed that does not embody any of the real essentials of sanitation. Such a barn consists usually of only a roof and rough, windowless, unsanitary sides and is in such shape that it would be impossible to remodel it so as to include the essentials of sanitation, convenience and comfort.

It is not the purpose of this circular to try to cover the whole field of barn construction but rather to give some of the fundamental principles which should be embodied in every dairy barn, together with floor plans and other designs which will be of service to the dairyman in planning a barn for himself. The general type of a barn that would be desirable under conditions existing on one farm or in one community may not be advisable in another, but the essential requirements for ventilation, air space per cow, and light, and for the best floor arrangement are more or less the same throughout the State.

ESSENTIALS IN BARN CONSTRUCTION.

Ventilation.—A plentiful supply of pure, fresh air is very essential in a dairy barn, both for the health of the cows and for the purity of their products. Tightly constructed barns that make it necessary to install some system of ventilation are rarely needed in this State. We do, however, need the doors and windows so placed and arranged that there will be a constant change of air without a direct draft on the cows. Ceiled barns should be equipped with flues which open flush with the ceiling, and are carried through the roof to a point three to four feet above the ridge. The flues assist in removing the warm air, thus keeping the barn cooler in summer. This ventilating flue may be made of wood or galvanized iron.

Air Space.—The interior of the barn should contain at least 500 cubic feet of air space per cow. This would make it necessary for the average height of the ceiling in a barn containing two rows of stalls to be approximately 9 feet. The air space per cow can be calculated by computing the cubical contents of the barn and dividing the result by the number of cows.

Light.—The direct sunlight is considered to be a valuable germicide. A dark, damp, filthy place is a good breeding place for disease germs and other germs of a detrimental nature. In order to keep a barn sweet and sanitary it is very important to have it well supplied with windows. A well-lighted barn is also much easier to keep clean. The windows should provide approximately 4 square feet of unobstructed lighting area per cow. In some instances, for the sake of economy, it may be necessary to leave the glass sash out, but in all cases the openings should be provided with some form of shutter which in winter may be open during the day and partly closed at night.

Floor.—The floor in the barn should be well constructed. The three common materials used for barn floors are clay, wood and concrete. A floor constructed of any one of these materials, if properly made and well cared for, is fairly easy to keep clean and sanitary. A clay or wooden floor, however, can be recommended only when the plans for future business are not definitely formed and when the necessary capital for a better floor is not available.

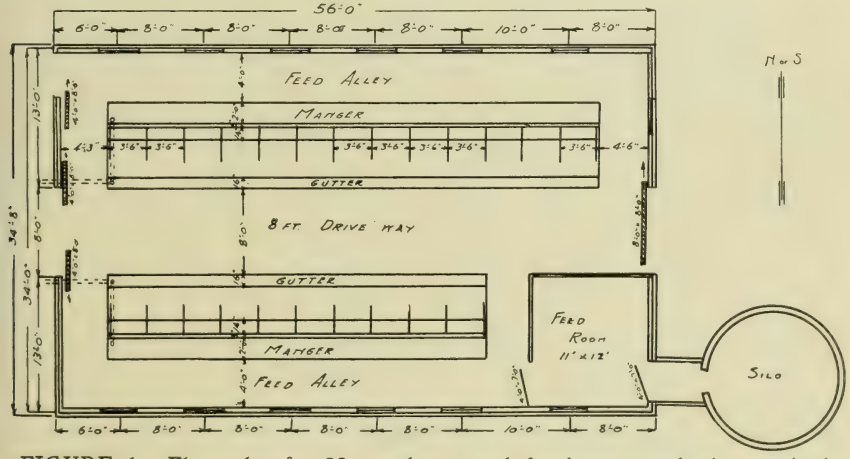


FIGURE 1. Floor plan for 23 cow barn, with feed room and silo attached.

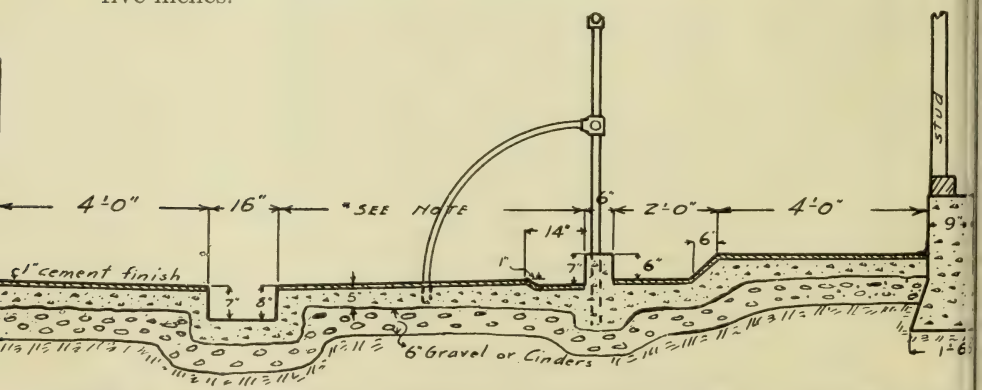
A fairly good clay floor can be made by mixing the clay with lime, wetting the mixture thoroughly and packing it firmly. This floor is easier to keep clean than an ordinary dirt floor but it will wear in places and need frequent repairing.

The wooden floor, when properly constructed, is probably a little easier to keep clean than the clay floor, but it is liable to be somewhat more expensive, depending on the local price of lumber and the grade

of material used. If ordinary sap pine is used, it will have to be replaced every few years. The boards should be laid tightly together to prevent any of the dropping and urine from seeping through the cracks and cause an accumulation of filth and a bad odor in the barn. A floor of very soft, open-grained wood is also objectionable on account of its tendency to absorb large quantities of the liquid manure. Either of the two floors described above, when considered for a period of years, is more expensive than the concrete floor, on account of the necessity of frequent repairing and replacing, and is less desirable from the standpoint of sanitation.

When the concrete floor is properly constructed and of good material it has several advantages over either of the other two types. It is very durable and requires but little expense for maintenance. It saves labor as it is easily kept clean, especially where running water is available. One objection against the concrete floor is the high first cost. As pointed out above, when considered for several years' service, the cost of constant repairing of other types more than equals the extra cost of the concrete. Other objections are that it is hard and cold. Both these difficulties, however, may be overcome by using plenty of bedding. Unless special precaution is taken in laying a concrete floor it is apt to be slippery. The surface should be dressed off with a wooden float but never polished with a steel float or trowel.

The stall equipment should be put in or provisions be made for its installation at the time that the floor is laid. The standard width of the stall is 3 feet, 6 inches. The depth of the stall varies according to the length of the cows. For average Jersey cows it should be 4 feet, 6 inches from the curb to the gutter. For medium-large cows it should be 4 feet. 8 inches, and for very large cows it should be 5 feet. The thickness of the floor throughout the barn, in every case, should be five inches.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16"
*SEE NOTE
6"
2'-0"
4'-0"
14"
6"
9"
6"
1"
7"
1"
1"
1

The manger should be 18 inches wide at the bottom, 24 at the top, and 6 inches deep. It should be separated from the floor of the stall by a 6 x 6 inch concrete curb. A feed alley 4 feet wide should be provided between the manger and the wall to give ample room to pass in front of the cows when feeding. The manger should never be placed closely against the wall. The bottom of the manger should be one inch above level with the floor of the stall, and should be polished with a steel float. For convenience in sweeping into the manger whatever feed may have been pushed out by the cow, the floor of the feed alley should be on a level with the top of the manger. A two-inch gas pipe may be imbedded in the concrete from one end of the manger to the gutter, to drain out the water used for washing the mangers.

Any of the floors described should be equipped with concrete gutters. Gutters may be made from boards if for temporary use, but they are difficult to keep clean and the sides frequently collapse from outside pressure, especially if used with the clay floor. In some instances, in which clay floors have been used concrete gutters have been put in with satisfactory results, extending the concrete 12 to 18 inches up under the hind feet of the cow, and the same distance on the side next to the walkway.

The interior of the barn should be annually whitewashed or painted. This will help preserve the walls, improve the appearance of the barn, and make it more sanitary.

Whitewash used by the Government is prepared as follows: Take one-half bushel of unslaked lime, slake it with boiling water, cover during the process, to keep in the steam; strain the liquid through a fine sieve or strainer and add a peck of salt previously dissolved by soaking in warm water, three pounds of ground rice boiled to a thin paste and one pound of clean glue, previously dissolved by soaking in cold water, and then hang it over a slow fire in a small pot hung in a larger one filled with water. Add five gallons of hot water to the mixture; stir well and let it stand a few days covered from dirt. It should be applied hot, for which purpose it can be kept in a kettle or portable furnace. The east end of the White House at Washington is embellished by this brilliant whitewash. It is used by the Government to whitewash lighthouses. A pint of this mixture, properly applied, will cover one square yard and will be almost as serviceable as paint for wood, brick or stone and is much cheaper than the cheapest paint. It is cheaper and better to apply the wash with a good brass spray pump. It will keep down flies and vermin in stalls as well as preserve the wood.

EQUIPMENT.

The equipment and arrangement should be so planned as to contribute to the comfort of the cows, to the sanitation of the barn, and to the convenience in the care and handling of the stock. The cows are fed and milked twice daily and a minute or two saved in each operation will amount to a great saving of time in a number of years.

Probably there is no better way of fastening the cow in her stall than by some form of swinging stanchion either steel or wooden. In making a selection it is well to keep in mind that the steel stanchion is the more durable and easier to keep clean but more expensive to install.

Wooden equipment can be made sanitary and convenient and can be constructed for a very small cost. Complete stalls and stanchions have been built in Mississippi barns at a cost of less than 40 cents per cow. Special material should be cut for making this equipment. The following is a bill of material for one stall complete:

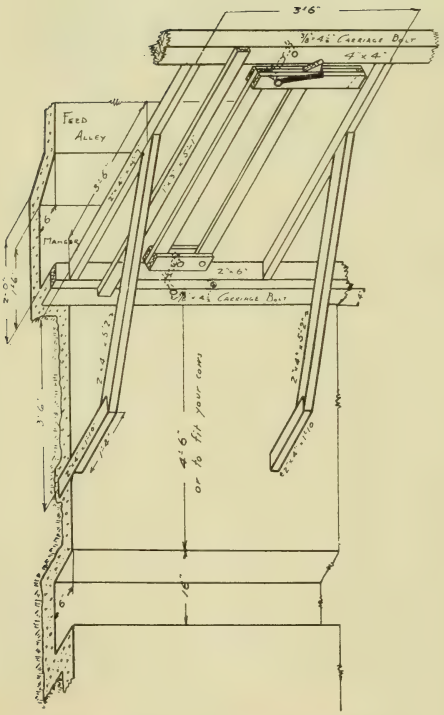


FIGURE 3. Wood stall and stanchion with concrete floor.

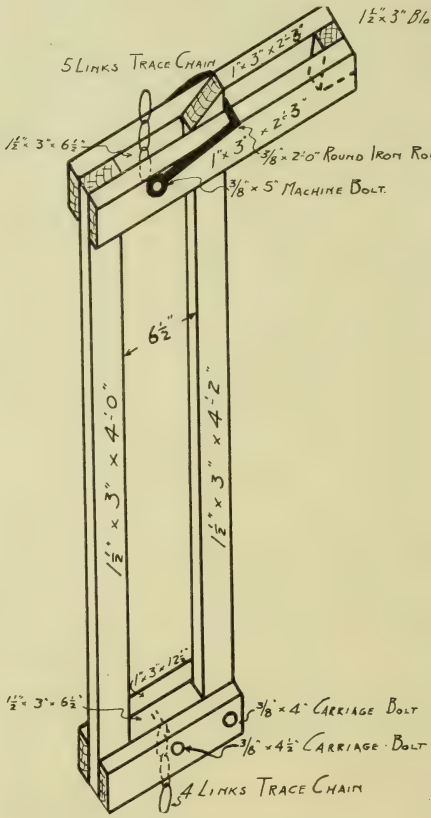

5 Links Trace Chain
1" x 3" x 2'-3"
1" x 3" x 2'-3"
3/8" x 2'-0" Round Iron Ro
3/8" x 5" Machine Bolt.
6½"
1½" x 3" x 4'-0"
1½" x 3" x 4'-2"
1" x 3" x 12"
3/8" x 4" Carriage Bolt
3/8" x 4½" Carriage Bolt
4 Links Trace Chain

FIGURE 4. Homemade wooden stanchion.

Stanchion.—

1 piece 1½″ x 3″ - 10′ long.
1 piece 1″ x 3″ - 7′ long.
2 pieces Trace chain, 5 links each.
2 3-8″ bolts 4″ long with washer.
2 3-8″ bolts 4½″ long with washer.
1 3-8″ bolt 5″ long with washer.
1 piece 3-8″ rod iron, 2′ long.

Stall.—

1 piece 2″ x 4″ - 10′ long.
1 piece 4″ x 4″ - 3′ 8″ long.
1 piece 4″ x 6″ - 3′ 8″ long.
1 piece 2″ x 4″ - 10′ long.

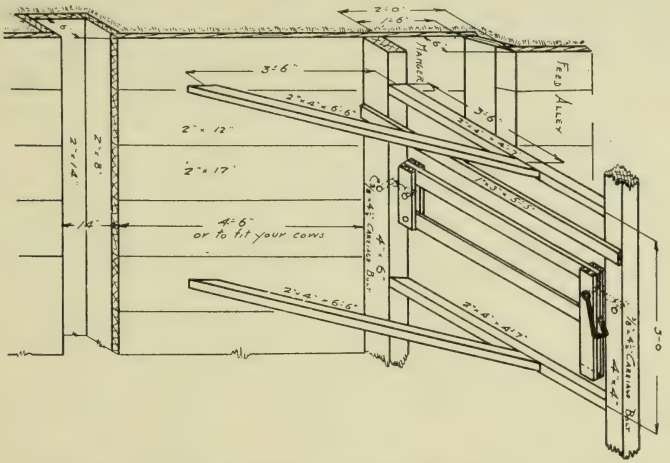


FIGURE 5. Wood stall and stanchion with board floor.

The lumber should be dressed on all sides. If the floor is constructed of clay or wood, 1 by 10 inch boards should be added to the bill of material to make the feed manger. As has been previously stated, this should be 18 inches wide at the bottom, 24 inches wide at the top, and 6 inches deep. In those barns in which the floor is constructed of concrete the manger also will be of concrete. If a wooden stall is to be built in connection with a concrete floor, the curb should be made 4 inches high and 6 inches thick with a 2 x 6 inch piece bolted down upon it. The stall framing should then be spiked to the 2 x 6 inch plank.

ADDITIONAL INFORMATION.

The agricultural engineering department of the college is in position to furnish blueprint plans and specifications for barns and for the installation of barn equipment.

Through the cooperative agreement of the extension department of the college and the Dairy Division of the U. S. Department of Agriculture, three extension dairymen have been placed in the State. These men will take pleasure in suggesting plans and supervising, in part, when possible, the erection of barns, and assisting in remodeling old barns and sheds for sanitation and convenience. This service is free on request. Address all inquiries to the Dairy Extension Department, Agricultural College, Mississippi.

BARN FACTS AND SUGGESTIONS.

1. For two rows of stalls the barn should be either 34 or 36 feet wide. If it is desired that the stalls shall be arranged for the cows to face the center alley, with a six-foot feed alley between the mangers, the barn should be 34 feet wide. If an eight-foot feed alley is desired, the barn should be 36 feet wide. If the stalls are arranged for the cows to face the outside walls, with an eight-foot driveway in the center, the barn should be 34 feet wide.

For one row of stalls the barn should be 17 feet wide.

2. Provide not less than 500 cubic feet of air space per cow.

3. The barn should be well ventilated.

4. The minimum amount of glass should be 4 square feet per cow. Plenty of light will help keep the barn sanitary.

5. The floor should be hard so that it can be easily kept clean.

6. Concrete floors should have the top surface dressed off with a wooden float. A steel float should never be used for this purpose.

7. The manger should be 18 inches wide at the bottom, 24 inches wide at the top and at least 6 inches deep.

8. Never put stationary divisions in the manger.

9. The manger should not be placed closely against the wall. For convenience in feeding, leave a four-foot passageway at each end of the stable, and in front of the mangers.

10. The stalls should be 3 feet, 6 inches wide and deep enough to accommodate the cows. This requires 4 feet, 6 inches for small cows, 4 feet, 8 inches for medium-sized cows and 5 feet, for large Holsteins.

11. Make the gutters 16 inches wide and 6 inches deep.

12. Provide the gutters with pipes for draining out the water from the barn after scrubbing the floor.

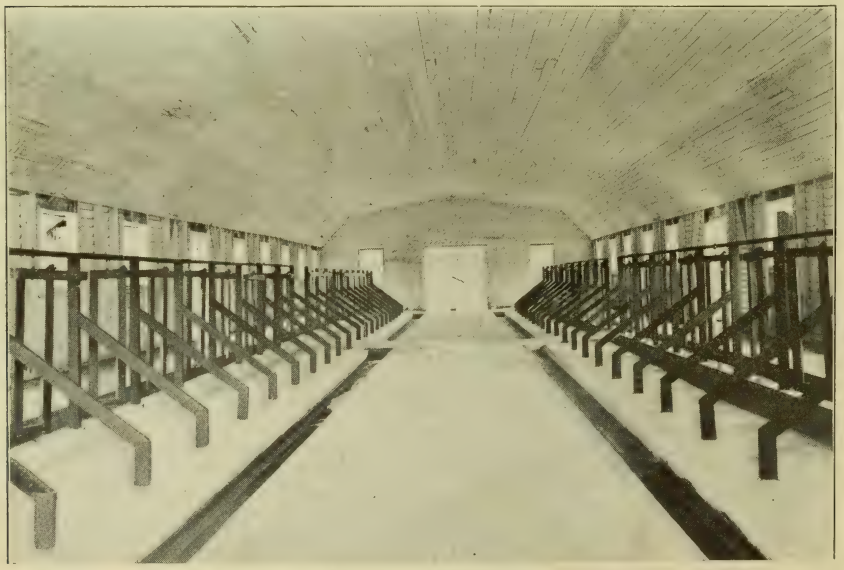
13. Use some type of swinging stanchion.

14. Make the ceiling of the barn so that it can be kept free from dust and cobwebs.

15. The ceiling in the cow stable in a two-story barn should be dust proof.

16. Whitewash the inside of the barn every year.

17. Paint the outside of the barn as often as is necessary. Paint preserves the wood and improves the appearance.



INTERIOR VIEW OF DAIRY BARN IN MISSISSIPPI, SHOWING WOOD EQUIPMENT WITH CONCRETE FLOOR. CAPACITY 40 COWS, COST $1025.00

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MINNESOTA EXPERIMENT STATION LIBRARY. No.

MISSISSIPPI

Agricultural Experiment Station

BULLETIN NO. 3.

S. M. TRACY, DIRECTOR.

ANALYSES OF COMMERCIAL FERTILIZERS SOLD IN MISSISSIPPI DURING THE SEASON 1887—8.

JOHN A MYERS,
STATE CHEMIST.

JUNE 20TH, 1888.

AN ACT

TO PROVIDE FOR ANALYZING FERTILIZERS, AND FOR OTHER PURPOSES.

SECTION 1. Be it enacted by the Legislature of the State of Mississippi, That each and every manufacturer and vendor selling or offering for sale, for use in this State, any commercial manures or artificially manufactured fertilizers, by whatsoever name called, animal excrement excepted, shall keep in his place of business, or possession, for inspection by the public, a fair printed analysis of the same.

SEC. 2. Be it further enacted, That the person occupying the chair of professor of chemistry in the Agricultural and Mechanical College at Starkville Mississippi, be and he is hereby declared ex-officio State Chemist.

SEC. 3. Be it further enacted, That it shall be the duty of the State Chemist to analyze samples of all fertilizers, whether natural or artificial, submitted to him by manufactures, vendors, or other persons with a certificate of his analysis.

SEC. 4. Be it further enacted, That every manufacturer of a fertilizer, which now is, or may hereafter be offered for sale in this State, shall, on or before the first day of November, 1882, submit fair samples of his manufacture to the State Chemist for analysis, and annually thereafter; provided, that if said manufacturer shall at any time make for sale any fertilizer of a composition differing from the articles previously analyzed, he shall, before offering such new manufacture for sale, submit a fair sample of the said new article for analysis, and in all cases the samples

must be taken from several sacks, boxes, barrels or other packages containing the same, and accompanied with an affidavit of the manufacturer or person submitting the samples for analysis, with the seal of the county affixed thereon, that the samples sent is a fair sample of the amount to be manufactured, sold or used.

SEC. 5. Be it further enacted, That every manufacturer of fertilizer shall pay to the State Chemist, for each analysis and certificate of the same, the sum of twenty dollars, and shall display in a conspicuous place in his office of business the certificate or certificates so furnished, for the inspection of every one purchasing or intending to purchase said fertilizer, and any manufacturer or vendor who shall sell or offer for sale any fertilizer without first complying with the provisions of this act, shall be guilty of a misdemeanor, and upon conviction thereof shall be fined not less than twenty-five, nor exceeding two hundred dollars, or imprisoned in the county jail not less than thirty days nor more than six months, or both such fine and imprisonment at the discretion of the court.

SEC. 6. Be it further enacted, That any person or persons purchasing any fertilizers from any manufacturers or vendors in this State, and who themselves (the purchasers) are citizens of the State, may, if they desire, submit fair samples of such fertilizers to the State Chemist, but in order to protect the manufacturer or vendor, from the submission for analysis of spurious samples, the person or persons selecting the same, shall do so in the presence of one or more disinterested persons, which samples shall be taken from one or more packages and bottled, corked and sealed in presence of said witnesses; and this sample package or bottle placed in the hands of a disinterested person, who is to forward the same at the expense of the purchaser to the State Chemist, when the purchaser so desires, and upon the receipt by him of any such sample package, the State Chemist is hereby authorized and required to analyze the same free of charge and return to such purchaser or purchasers a certificate or certificates of analysis. The certificates shall in all cases set forth the components of said fertilizers with their respective quantities, date of analysis and the name or names of persons submitting the samples, and be signed by the State Chemist, who is hereby required to keep an accurate record of the same, and the said certficates or

record when verified by the affidavit of the State Chemist, shall be competent evidence in any court of law or equity in this State.

SEC. 7. Be it further enacted, That Justices of the Peace shall have authority to bind persons offending against the provisions of this act, in a sufficient bond, for their appearance to the Circuit Court in accordance with the provision of the Code of 1880.

SEC. 8. Be it further enacted, That it shall be the duty of every manufacturer of fertilizers selling in this State to furnish his vendor with a certificate copy of the certificates of all of the samples analyzed by the State Chemist.

SEC. 9. Be it further enacted, That any person purchasing any fertilizer from any manufacturer or vendor, who shall, upon analysis by the State Chemist, discover that he has been defrauded, by reason of adulterations or deficiences of constituent elements, either of quantity or quality in the fertilizer so purchased, shall recover in any action he may institute, upon proof of the fact, twice the amount paid to or demanded by the manufacturer or vendor of the same, but in all cases where said vendor is an agent of a manufacturer, or a sub-agent, the judgment of the court shall be rendered against the manufacturer, unless upon trial the said agents are found to be guilty of the frauds perpetrated. And in case, the purchase is made of a manufacturer, or of an agent of any person or persons residing out of the limits of the State of Mississippi, manufacturing, compounding, preparing and furnishing for sale any such commercial manures, or artificially manufactured fertilizers, the purchaser thereof may, at his option, proceed by attachment, as is now provided by law in cases of non-residents and absconding debtors against any property, rights of credit of any person or persons selling, manufacturing, compounding or furnishing said manures or fertilizers, when such property, rights and credits can be found within the limits of this State.

SEC. 10. Be it further enacted, That this Act take effect and be in force from and after its passage.

Approved, March 8th, 1882.

AN ACT TO AMEND SECTION 5 OF ABOVE LAW.

SEC. 1. Be it enacted by the Legislature of the State of Mississippi, That section 5 of chapter 24, of sheet Acts of 1882, be amended by striking out State Chemist in third line

and inserting Treasurer A. M. College, for the benefit of said College, to be accounted for by said Treasurer in his reports.

SEC. 2. Be it further enacted, That this Act take effect and be in force from and after its passages.

Approved March 1st, 1884.

AN ACT.

To amend An Act Entitled "An Act to provide for analyzing fertilizers and for other purposes, approved March 8th, 1882.

SEC. 1. Be it enacted by the Legislature of the State of Mississippi, That any citizen of the State desiring to have a fertilizer analyzed, shall in addition to other requirements of the above recited Act be required to furnish to the State Chemist a certificate of two or more persons, certifying that the sample of fertilizer forwarded to the State Chemist for analysis, is a sample of a fertilizer sold in the State.

SEC. 2. Be it further enacted, If the State Chemist shall fail or refuse to analyze said fertilizer and furnish a certificate of analysis as directed by the above recited Act without good and sufficient cause, that the Board of Trustees of the A. & M. College are hereby authorized and required to remove said State Chemist from the Chair of Professor of Chemistry in the A. & M. College, and appoint his successor.

SEC. 3. Be it further enacted, That this Act be in force from and after its passage.

Approved February 17, 1888.

In order to facilitate the carrying out of the provisions of the law the following printed instructions for taking and shipping the samples together with the blanks to accompany the samples are issued.

DIRECTIONS

For Taking Sample of Fertilizing Material for Analysis.

1. If you have a fertilizer sampler, open the sacks or barrels

and thrust it into the material the full length of the sampler, and then remove this quantity from the sack. Pour all of the samples thus taken (from at least 10 per cent. of the number of packages in the lot) together, and mix thoroughly. From this lot, thus mixed, fill the can (containing at least 1 lb.,) seal and label with the label furnished by the State Chemist.

II. If you do not have a fertilizer sampler, take a large shovel full or scoop full from the sacks, as directed in I., mix and sample in like manner.

III. The sample should be put into a tin can and soldered tightly. If this is not to be had, a sample shipped in a well sealed fruit jar will be received, should it arrive in good condition. If not, it will be rejected. The sample from farmers must be taken in the presence of two witnesses, who must subscribe to the Certificate. Fill out the Certificate and send by mail, at the time you ship the sample.

IV. No samples of fertilizers will receive attention from the Chemist where these conditions are not complied with. One portion of the sample is analyzed, and the remainder carefully preserved for the protection of the Chemist, should the analysis lead to complications.

V. The samples sent as above directed will be analyzed as soon as possible after reaching the Laboratory. No fee will be charged where the sample is sent by a farmer or planter; but no certificate will be given to a manufacturer, vendor, agent, subagent, etc., until the fee, $20, required by law has been paid.

VI. All express or freight charges must be prepaid by the person who sends the package.

LABEL FOR CAN OR BOTTLE.

For sake of convenience and ease in identifying samples all parties are requested to use the following label which will be furnished with the blank certificates free of cost.

LABEL FOR CAN.

IN WHICH FERTILIZER IS SHIPPED TO THE STATE CHEMIST.

Name or Brand of Fertilizer .....

Trade Mark, if any .....

Manufacturer's Name .....

Manufacturer's Address .....

CLAIM OF MANUFACTURER.

Available Prosphoric Acid ..... per cent.

Nitrogen (or Ammonia, if claimed) ..... per cent.

Potash (if claimed) ..... per cent.

Name of Sender (sign) .....

☞PREPAY ALL CHARGES.☜

Send by Express, to

JOHN A. MYERS.
State Chemist.

A. & M. COLLEGE, STARKVILLE, MISS.

Form of Certificate Provided for the Farmer to Send Along With the Sample.

It is expected that this will be sent by mail as they generally arrive in a damaged condition when enclosed in the package with the fertilizer by express.

Post-Office Address of Sender .....

Date.....

I certify that the sample of Fertilizing Material sent to you this day, was taken according to the regulations prescribed by law and that it represents fairly the chemical composition and physical condition of this article as offered for sale by ..... (name of dealer)

(address of dealer.) ..... This fertilizer is called ..... and has the trade mark (if any) .....

Manufacturer's name .....

Manufacturer's address .....

The number of sacks or packages sampled .....

If called upon I would swear to the above.

Signed .....

We certify that we saw the above described sample taken, sealed, labeled and shipped, and the above statement is correct.

Names of witnesses, sign.....

.....

Post-Office address of witnesses,.....

.....

ADDRESS. JOHN A. MYERS.

Agricultural College, Miss.

Certificate for Manufacturers and Dealers.

(This Certificate must Accompany each Sample sent for Analysis under the law "Providing for Analyzing Fertilizers.")

Post-Office Address of Sender .....

Date ..... 188..

This Certifies that the sample of Fertilizing Material sent to you this day, in a sealed ....., represents the article fairly, both in Chemical Composition and Physical Condition, as it is offered for sale by me.

This Fertilizer is called .....

and has the Trade Mark (if any) .....

Manufacturer's name .....

Manufacturer's address .....

The amount from which the sample was drawn .....

Cash price asked, $ ..... Per Ton.

Number of Tons sold in Mississippi per year ..... (If not exactly, approximately.)

STATE THE COMPOSITION AS CLAIMED BY THE MANUFACTURER:

Available Phosphoric Acid ..... Per Cent.

Nitrogen (or Ammonia ..... per cent, if claimed.)

Potash ..... Per Cent.

..... Per Cent.

..... Per Cent.

..... Sign.

Sworn to before me this ..... day of ..... 188..

.....

Seal of Notary Public.

In payment of Fee, $20, required by law, send either draft on New York, or Post-Office Order, payable at Starkville, Miss. Draft upon local banks will not be accepted.

ADDRESS to

JOHN A. MYERS,

Agricultural College,

OKTIBBEHA CO., MISS.

THE VALUATION.

The valuation of fertilizers is based upon the prices at which the ingredients AVAILABLE PHOSPHORIC ACID, NITROGEN and POTASH can be had for cash. In placing the valuation adopted upon these, regard is had to the HIGHEST CASH VALUE ONLY that it is necessary for farmers to pay to secure the ingredients named. At points where freight rates are favorable they will cost less. At any railroad point in this State the fertilizers can be had at prices not exceeding those given and where the farmer is asked to pay more it will be to his advantage to inquire elsewhere. Where a credit is demanded by the farmer, as is too frequently the case, he will have to rely upon his ability to make favorable terms with his supply-merchant. But where he agrees to give a bale of cotton for a ton of fertilizer, as I am informed is frequently demanded, he certainly cannot boast of having a very high credit among those with whom he deals. It would be well in such cases for the farmer to inquire if fertilizers cannot be secured at cheaper rates in some other form, that will be equally as effective.

This season Available Phosphoric Acid is estimated at 8 cts. per lb.; Nitrogen at 18 cts., and Potash at 6 cts. per lb. No valuation is assigned to Insoluble Phosphoric Acid, and Reverted Phosphoric Acid is estimated as part of the Available Phosphoric Acid.

The farmer can apply the valuation himself to any brand by noticing its analysis. For example: What is the relative commercial value of Stern's Am'd. Superphosphate? Turning to the Table of Analysis, we find the following composition per 100 lbs. This multiplied by 20 reduces it to tons and by the price per pound gives the price of each ingredient in the ton. Add up the three values and you have the total value per ton:

	%			Cts.		
AVAILABLE PHOSPHORIC ACID,	11.25	x	20	x .8	=	$18.00
NITROGEN,	2.68	x	20	x 18	=	9.64
POTASH,	1 92	x	20	x .6	=	2.30
Value per ton of 2000 lbs						$29.94

In the case of an Acid Phosphate there will be no Nitrogen and generally no Potash, though that is some-

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times mixed with it, as may be seen from the analysis. The moisture is given as a check upon the analytical work and also to indicate how dry the sample was that was submitted to the chemist for analysis. If the farmer buys a fertilizer with 20 per cent. of moisture, or containing 20 lbs. of water per 100 lbs., of course he gets less fertilizer than where he selects one having only 12 lbs. of water per 100 lbs., other things being equal. The moisture in fertilizers is constantly changing with the condition of the atmosphere. This variation of moisture which is unavoidable, causes a variation within a certain small limit of the analyses made at different times, even supposing the chemist to be invariable in his work, which is not the case. There is necessarily a small error in manipulation. For example it is not possible to weigh the same quantity to the exactness required by an analysis without a small per cent. of error every time. This error together with others, creeps into the analytical work in spite of all that can be done, though it certainly becomes quite small after the same operation has been gone through with several thousands of times, as has been done in our work. A slight variation in analyses therefore does not mean fraud upon the part of the manufacturer. This variation of samples and in the work will effect the valuation of a fertilizer as much as $2.00 per ton, and farmers may expect samples sent in by them to vary as much as that from the sample provided by the manufacturer, supposing each sample to be selected with due care.

The directions sent out for the taking of samples should be followed quite closely by those not familiar with taking samples of fertitizers. And while it is an easy matter to get a fair sample by other ways perhaps, yet experience in sampling is certainly of the greatest importance in the selection of samples and much trouble and annoyance may be avoided by being especially careful in this respect.

THE FARMERS CAN NOT OBSERVE TOO GREAT CARE IN THIS RESPECT AS THE RULINGS OF THE COURT IN THE CONTESTED CASES ARE SUCH AS TO REQUIRE THAT EVERY POSSIBLE PRECAUTION SHOULD BE OBSERVED IN THE SELECTION AND HANDLING OF SAMPLES.

The largest case under this law that has come into the courts in this State was lost upon that ground.

The attention of the farmers is especially directed to the fact that the law requires a FAIR SAMPLE to be sent in for analysis, if the farmer wishes to avail himself of the provisions of the law. It does not contemplate the analysis of any other kind of samples, and the chemist would not be justified in analyzing what upon its face bears the evidence of being, either an unfair sample or a sample damaged by the farmer himself, or during transportation. For example, at the time of this writing, three samples have just arrived by mail in a small paper box, from an interior post office. They were done up in little paper packages containing an insufficient amount for making an analysis, in the first place, and in the next place, during the transportation the little papers got broken open and all three are mixed up with one another. They are worth nothing. Under ordinary conditions a farmer should send in not less than about one pound of every brand that he wishes analyzed. It is possible then, in a measure, for the chemist to overcome the difficulties produced by lack of experience in sampling. Justice to manufacturers and protection to legitimate trade requires that utmost care be observed in the selection of the samples.

It is desirable to have samples which will represent the quality of goods sold in neighborhoods rather than those selected from separate sacks that comes into the hands of the farmers, and samples should in all cases where possible, be drawn from several sacks. It is rarely the case that the farmer without a regular fertilizer sampler, can secure an average sample from a single sack. An analysis shows what is in the sample analyzed and if a mistake be made in selecting that sample the result may do serious injustice to innocent parties. It is to be hoped that in future more care will be exercised in the selection, packing and shipping of the samples, by those sending them in for analysis, whether farmers or manufacturers, as by so doing they will frequently avoid the annoyance of having to send in new samples. There is this year an unusual amount of uneasiness among the farmers concerning fraud in fertilizers. There have been more samples sent in for analysis than usual and the analyses given do not include any of the samples sent in by the farmers. The reason for this uneasiness may possibly be that the

whole question of adulterations is receiving more than usual national attention, or it may be that as the farmers become more thoroughly organized and have their attention more frequently directed to the fertilizer problems, the question of purity of the fertilizers becomes more important.

It will be to the interests of all parties to have the business upon a thoroughly reliable basis and it is to be hoped that all manufacturers shipping goods into the State or delivering them to the farmers will exercise special care to keep them up to the grade of the samples sent in by them under our law for analysis. By so doing they may save themselves a large amount of trouble and litigation, for with the number of samples coming in for analysis, a carload of short goods is very likely to reach parties who will send in samples of it for analysis. Our system of inspection is extremely lax and may appear to be easily evaded; but it is not unattended by considerable risk.

It is especially desirable that the agents of the various companies in the State should take special care to deliver only such goods as are fully guaranteed. The business is developing in the State, and as confidence becomes established in the quality of the goods it will rapidly extend.

The farmer if he will simply observe the requirements of the law has ample protection, even though the manner prescribed by the law for carrying it out is inconvenient and more or less unsatisfactory to all parties.

I do not think that there is any well founded cause for complaint in most of the cases, and believe the most of the fertilizers in the State to be honestly prepared goods. Occasionally a carload of short goods may find its way into the State, but it certainly is the exception, I think, rather than the rule.

No.	Manufacturer's Name.	P. O. Address.	State.
1	North West Fertilizer Co	Union Stock Yds., Chicago,	Ill
2	Adairs Brothers & Co	Atlanta,	Ga.
3	John Merryman & Co	Baltimore,	Md.
4	Standard Guano & Chemical Mfg. Co	New Orleans,	La.
5	The Jackson Fertilizer Co	Jackson,	Miss
6	The Jackson Fertilizer Co	Jackson,	Miss
7	The Jackson Fertilizer Co	Jackson,	Miss
8	The Jackson Fertilizer Co	Jackson,	Miss
9	North West Fertilizer Co	Union Stock Yds., Chicago,	Ill
10	North West Fertilizer Co	Union Stock Yds., Chicago,	Ill
11	North West Fertilizer Co	Union Stock Yds , Chicago,	Ill
12	Robt. B. Brown Oil Co	St. Louis,	Mo.
13	Imported by Meridian Fertilizer Co	Meridian,	Miss.
14	Davis, Marshall & Co	Mobile,	Ala.
15	Davis, Marshall & Co	Mobile,	Ala
16	Columbus Oil Mills	Columbus,	Miss
17	Baldwin Fertilizer Co	Savanah,	Ga.
18	Bradley Fertilizer Co	Boston,	Mass
19	Bradley Fertilizer Co	Boston,	Mass
20	Furman Farm Improvement Co.	Atlanta,	Ga
21	Furman Farm Improvement Co	Atlanta,	Ga
22	Planter's Fertilizer Mfg. Co	New Orleans,	La.
23	Meridian Fertilizer Factory	Meridian,	Miss
24	Meridian Fertilizer Factory	Meridian,	Miss
25	Pacific Guano Co	Boston,	Mass
26	Pacific Guano Co	Boston,	Mass.
27	Standard Guano & Chemical Mfg. Co	New Orleans,	La.
28	Robt. B. Brown Oil Co	St. Louis,	Mo
29	Clark's Cove Guano Co	New Bedford,	Mass
30	Clark's Cove Guano Co	New Bedford,	Mass
31	The Raisin Fertilizer Co	Baltimore,	Md.
32	The Raisin Fertilizer Co	Baltimore,	Md.
33	Lister's Ag'l. Chemical Works,	Newark,	N. J.
34	Meridian Fertilizer Factory	Meridian,	Miss
35	Standard Guano & Chemical Mfg. Co	New Orleans,	La.
36	Standard Guano & Chemical Mfg. Co	New Orleans,	La.
37	The Raisin Fertilizer Factory	Baltimore,	Md.
38	National Fertilizer Co	Nashville,	Tenn
39	National Fertilizer Co	Nashville,	Tenn
40	National Fertilizer Co	Nashville,	Tenn
41	George W. Scott Mfg. Co	Atlanta,	Ga.
42	The Jackson Fertilizer Co	Jackson,	Miss
43	The Meridian Phosphate Co	Meridian,	Miss
44	John Marback	Bracken,	Texas.

	Name of Brand.	Soluble Phosphoric Acid	Reverted Phosphoric Acid.	Insoluble Phosphoric Acid.	P2 O5 Available	Nitrogen	Potash.	Moisture.	Value Per Ton
1	Ammoniated Dissolved Bone	7.75	2.11	3.65	9 86	2.80	.93	14.02	26.98
2	Adair's Ammoniated Dissolved Bone	9.41	0 54	2 10	9 65	2.78			25.45
3	Ammoniated Dissolved Bone	8.28	0.83	3 96	9.11	2.20	2.03	12 14	24.92
4	Stern,s Ammoniatd Rane Bone Superphosphate	10 62	.63	.55	11.25	2.68	1.92		29.94
5	Ammoniated Superphosphate	7.85	1.34	2.58	9.19	2.03	2.56	4 42	25.47
6	Ammoniated Superphosphate, Vegetable and F uit Grower	2.88	3 54	0.90	6.42	3.72	7.27		32.30
7	Ammoniated Superphosphate Royal C. Brand	10.20	1.54	.89	11.75	2.59	2.46		31 07
8	Ammoniated Superphosphate	7 37	.80	.83	8.17	2.45	3.70		26.33
9	Atkinson's Pelican Cotton and Corn Grower	7.59	2.15	3 89	9.74	2.80	.93	13.54	26.78
10	National Bone Dust	7.53	2.45	3.41	9 98	2.87	.96	13.51	27 45
11	Knicherbocker Dissolved Bone	7.75	2.45	3 54	10.20	2 73	.93	14.20	27.27
12	Brown's Cotton and Corn Fertilizer	9.24	.96	1.14	10.20	3.45	2.48	13.31	31.68
13	English Acid Phosphate	11.79	1.31	1 06	13.10			18 29	20 96
14	Magnet Soluble Guano	4.85	1.74	2.73	6 59	2.95	1.54	11.58	23.01
15	Magnet Acid Phosphate	10.62	4 14	2.04	14 76			13 85	23.61
16	Standard (P. A. P.)	4.52	4.41	2 10	8 93	2.91	3.33	8 80	28.55
17	Georgia State Grange Fertilizer	9.58	.54	1.85	9.92	1 80	2 51	16.60	25.36
18	B. D. Sea Fowl Guano	8.90	1.93	3 10	10.83	2.60	.36	12.23	27.04
19	Palmetto Acid Phosphate	13.39	.81	1.19	14 20			13.69	22 72
20	Farish Furman Farmula	9.49	2.13	1.10	11.62		2 40	14.30	21 47
21	Buffalo Bone Guano	8.48	.77	1.21	9.25	2 17	1.65	17.40	24.57
22	Planters Fertilizer Manufacturing Company's Cotton Fertilizer	7.84	1.33	.31	9 17	2 06	1.98	13 80	24.47
23	Bone and Potash	7 69	2.26	1.65	9 95		1 88	15 92	18.17
24	Standard Home Mixture Guano	6.61	2.51	1.66	9.12	2.06	2.38	12.24	25.43
25	Dissolved Bone Phosphate of Lime	10.22	2.92	3 81	13.14			12.54	21.02
26	Saluable Pacific Guano	6.63	3.98	2 97	10.61	2.61	1.45	14.51	28.11
27	Stern's Acid Phosphate	12.57	2.07	.38	14.64			15.83	23.42
28	Eddy stone Soluble Guano	7.50	2.20	2 80	9.79	2.25	1.60	16 07	25.54
29	Sunny South Acid Phosphate	9 26	3 34	2 99	12.60			14.07	20.16
30	Mobile Standard Guano	6.49	3.66	3.40	10.15	2.87	2.97	11.29	30.01
31	Soluble Sea Island Guano	6.70	3 60	3 64	9.70	2.83	3.03	11.60	29.33
32	Lister's Standard Phosphate	10 01	2.03	2.40	12.04	2.30	2 06	10.91	30 01
33	Standard Home Mixture Guano	8.13	2.80	1.70	10.93	2.62	2-76	11.26	30.23
34	Stern's Pure Ground Raw Bone			23.24		4.32			34.14
35	Kainite						12.10	3 04	14.52
36	Empire Guano	6 11	3.98	3.52	10.09	2.87	2.94	11.30	29.69
37	Rock City Superphosphate	6.37	1.59	2.23	7 96	3.05	2.52	19.59	26.73
38	Tennessee Superphosphat	6.16	2.27	3.22	8.43	2.34	2.23	14.83	24 05
39	Vegetable Grower	7.94	2 96	1.17	10.90	3 03	2.70	19.56	31 58
40	Gossipium Phosphate	7.64	1 19	2.81	8.83	2.77	2.37	13.92	26.94
41	Acid Phosphate	13.93	.44	.86	14 87				23 00
42	Ammoniated Raw Phosphate	2.05	.69	.20	2.74	3.29	1.98		18.59
43	Texas Bat Guano	.35	5.93	10.54	6.26	3.40	.49		22.85

THE MANUFACTURE OF COMMERCIAL FERTILIZERS.

Within the last twenty years a business involving several millions of capital, employed in the manufacture and handling of commercial fertilizers has been developed.

These commercial or chemical fertilizers are of several classes. The names of the brands under which they are sold, however, means nothing, being gotten up by the manufacturers for their own private purposes or to gratify the whims of an unsuspecting mass of purchasers. The more fantastic the name in some cases the more they appear to sell of the brand. It is not uncommon for at least half a dozen brands to come from the same source and from the same heap. A manufacturer may in this way frequently be selling twenty or more brands from the pile in which they all have as nearly the same composition as it is possible for them to be manufactured.

The crop reports giving the results of experiments with several brands are to be taken for what they are worth, showing as they very frequently do the effect of the same fertilizer, under the variations that occur in the experimental plats, rather than the relative excellence of the different brands as is usually claimed for them by their agents or representatives. For example brand "X" is sold as "T" and "M" and "K" and "W" all taken from the same heap at the factory but all sold by different dealers, under their respective names. These brands are sent out for the farmers to experiment with. One farmer gets all of these brands, and carries on his experiment honestly and as directed. When he comes to harvest his crop he finds a very considerable variation in the results in nearly every case. He and the dealer at once jump at the conclusion that "K" is the brand for him to buy, and he is willing to pay several dollars more per ton for it than for "X" which in the experiments that he conducted did the poorest of any of the brands that were tried. And yet they are the same goods. His experiment showed, if he had known how to interpret it, the variation in the results that he may expect to have in the use of fertilizers rather than the result that he supposed it to give. This illustrates one of the difficulties that farmers encounter in the selection of fertilizers. They frequently are misled by

this kind of experiments, to pay dearly for their lack of knowledge of the true nature of the fertilizers in the markets.

The following classification of fertilizers may aid the farmer in getting at the true nature of the fertilizers offered in his neighborhood.

1. *ACID PHOSPHATES OR SUPERPHOSPHATES.*
2. *AMMONIATED SUPERPHOSPHATES.*
3. *BONE MEAL.*
4. *NATURAL GUANO.*
5. *VEGETABLE AND ANIMAL MATTER.*
6. *MINERAL FERTILIZERS.*

If we discuss them in order we shall cover the whole question of the manufacture of fertilizers so far as the farmer is interested in the origin of those that come into our markets in the south.

1. ACID PHOSPHATE OR SUPERPHOSPHATE—Contains phosphoric acid in three forms. Bones and phosphate rock contain an insoluble [in water] form of phosphoric acid which the manufacturers convert into a soluble form by treating these bodies with sulphuric acid, usually called the Oil of Vitriol. By the chemical change which takes place in the bones or phosphate rock subjected to this action the greater portion of the insoluble phosphoric acid becomes soluble in water thus becoming readily available as plant food. This is designated soluble phosphoric acid, of which an acid phosphate should contain from 12 per cent to 15 per cent. Then there is a portion not fully acted upon which is only partially converted into the soluble form, called in the trade reverted, or precipitated phosphoric acid of which there is usually from 1 1-2 to 3 1-2 per cent. The "Total Available Phosphoric acid being the sum of the soluble and reverted contained in the sample, which in a good sample should not be less than about 14 per cent.

Frequently the manufacturers sell the acid phosphate, mixed with some of the potash compounds still calling it acid phosphate, but it should be called acid phosphate with potash.

All acid phosphates contain a fair percentage of sulphate of calcium or land plaster, produced by the chemical changes that take place in dissolving the phosphate

rock or bones. It is therefore not an impurity, and it may be an advantage.

2 AMMONIATED SUPERPHOSPHATES—Are produced by mixing with the Acid Phosphate some nitrogenous matter, and usually also some potash salt such as Kainite or Muriate of potash, to give the fertilizer the desired potash. If the fertilizer comes from the East it is usually ammoniated with fish scrap, or some other animal residue; if it comes from the North or West it is usually ammoniated with tankage, dried blood or some similar product. If it be mixed in the South, it is most generally ammoniated with cotton seed meal. Sometimes they introduce a small percentage of nitrate of sodium, or Chili-saltpeter, which is most excellent but adds materially to the cost. These usually contain 8 to 10 per cent of available phosphoric acid, 2 to 3 per cent of nitrogen acid, 2 to 3 per cent of potash, the latter being omitted in a few brands.

3. BONE MEAL—This is simply ground bones obtained in various manufacturing processes, and by grinding bones especially for that purpose. It is a most excellent fertilizer. It usually contains from 4 per cent to 7 per cent of Nitrogen and about 23 per cent of Phosphoric acid. The finer it is ground, the more readily it will become available as plant food, and when VERY FINE is about as available as dissolved bone.

4. GUANO— This is not offered for sale in Mississippi and is probably not used in the manufacture of any of the brands sold in the State. There is one brand of Texas bat guano sold in the State. This is derived from the manure and also possibly to a certain extent from the dead bats, where they congregate in great numbers in caves. It is of great variation in composition, no two samples of it sent in for analysis showing equivalent qualities of plant-food. It is subject to wasting in the caves or to other causes leading to the widest range of value. Sometimes it approaches ordinary guano in composition but is generally, I think, scarcely equal to good cotton seed meal as a fertilizer. The company shipping this product into the State has gone into bankruptcy and I presume the last of it has been sent in, that will be delivered for a long time. It appears to have been used with some profit at some points in the State, and might possibly continue to be, if it came into the market. The nat-

ural guanoes have been wholly driven from our market by the cheaper commercial fertilizers.

5. Vegetable and Animal Matter—Under this head I may mention cotton seed and its products, the various kinds of oil cake, the wastes from various processes of manufacture, such as the sugar refineries, slaughter houses, desiccating establishments, soap factories, &c. These generally come into the market in a form which requires that they be mixed with some other fertilizers to get the best results. For example, cotton seed meal by itself is too rich in nitrogen to be used to the best advantage without mixing with some material supplying phosphoric acid and potash. The same is true generally of slaughter house products &c. These materials are largely used by the manufacturers of fertilizers for supplying the nitrogen. For example, the cotton seed oil mills find a market for part or all of their cotton seed meal by mixing it with Acid Phosphate and Kainite or Muriate of potash. It increases the market for both and is undoubtedly an advantage to the State to have its products utilized in this manner. These waste products are thus frequently made to yield excellent profits.

6. Mineral Fertilizers—Under this head may be named the crude phosphate rock in the form of Floats, Marl, Nitrate of soda, Kainite, Muriate of Potash, and land plaster. The Marl exists in many parts of the State and can be had for the cost of loading, transporting and spreading upon the land. It is not a commercial article. The Floats has been used to a limited extent but has not sustained itself sufficiently well to remain in the market.

The Kainite, Muriate and Nitrate are all quite largely used in mixing with other ingredients and to some extent independently upon the land in portions of our State. They are sold in small quantities to the farmers generally but should receive more attention from them, as without doubt they may be made valuable adjuncts to fertilizing materials produced upon the farms. The farmers will find it largely to their advantage to utilize the home supply of manure supplemented with these Mineral manures and Acid Phosphate, instead of buying so much of the Ammoniated Superphosphates.

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MISSISSIPPI

Agricultural Experiment Station

BULLETIN NO. 4.

S. M. TRACY, DIRECTOR.

THE MARLS OF MISSISSIPPI.

W. L. HUTCHINSON, Chemist.

NOVEMBER 7TH, 1888.

THE MARLS OF MISSISSIPPI.

We are an agricultural people. If we would prosper we must become familiar with the principles which un derlie successful agriculuture. The criminal system of the past which has despoiled and exhausted such extensive areas of once fertile and favored sctions must give place to a system of agriculture more rational and intelligent. Realizing the influence which marls may have on the agriculture of a State in which they occur as extensively as they do in this, we have thought it well to collect and embody in a bulletin such information concerning them as will enable every citizen in whose hands this bulletin may fall to properly estimate their value, and to intelligently decide when and where it will be profitable to use them.

Marls consist essentially of carbonate of lime mixed with more or less sand and clay. They frequently contain also small quantities of phosphoric acid and potash. The two latter, with the carbonate of lime, constitute their valuable ingredients.

A brief paragraph on the two classes of chemical manures is given in order that the action of marls may be better understood.

The two classes referred to are known as STIMULANT and NUTRITIVE fertilizers. Stimulant fertilizers do not serve directly as plant food, nor is their action in the soil similar to that of stimulants in the animal body. Their office in the soil is to dissolve, to bring in solution, to make available the "locked up" plant food ingredients that exist in the minerals of the soil as well as that of

the incorporated vegetable matter. What the atmospheric agencies, and the waters of the soil,—the usual solvents of nature.—would require centuries to accomplish may be done in a few years by the use of stimulant fertilizers. As this class of fertilizers do not contain the ingredients with which they furnish the plant, it is plain that a persistent use of only such fertilizers must result in an early exhaustion of the soil. Lime is prominent as a stimulant fertilizer. Practice for ages has shown that its application on many soils is productive of the very best immediate results; it has at the same time given rise to such expressions as "Lime kills the land." "Lime enriches the father but impoverishes the son;" or "He who limes without manure will leave his farm and family poor."

On the other hand true or nutritive manures serve directly as food for plants. They may be supplied from year to year in quantities sufficient for the growing crop or else an excessive amount may be added which will constitute so much increased wealth of the soil. The most economical plan however is to supply from time to time just that quantity which will be appropriated by the crop, as the soluble plant food of to day is the insoluble of to-morrow, and what is worse, is perhaps washed out and lost to the soil and succeeding crops forever. If then, to preserve and in some instances to improve the original fertility of the soil constitutes a rational system of agriculture, then must both these classes of manures be judiciously applied.

Lime, as has been stated is a stimulant fertilizer.—Phosphoric acid and potash are nutritive fertilizers; a marl then that contains appreciable quantities of the latter ingredients, not only releases the insoluble plant food contained in the soil by the action of the carbonate of lime, but furnishes in an available form two of the three ingredients which are soonest exhausted from all soils.

The benefits which have accrued from their use is thus easily explained.

While the solvent action of lime in the soil is perhaps its most valuable property, it is recognized to perform many other important functions. We cannot do better than quote from Dr. Eug. W. Hilgard, former State Geologist, as to the functions of lime in the soil. The following is taken from his report of the Cotton Production in Mississippi, published in the Tenth Census Reports of the U. S.:

(a.) "A more rapid transformation of the vegetable matter into active humus, which manifests itself by a dark or deep black tint of the soil.

(b.) The retention of such humus against the oxydizing influences of hot climates.

(c.) Whether through the intervention of this humus, or in a more direct manner it renders adequate for more profitable culture percentages of phosphoric acid and potash so small that in the case of the absence or deficiency of lime, the soil is practically sterile.

(d.) It tends to secure the proper conditions of nitrification whereby the inert nitrogen of the soil is rendered available.

(e.) It exerts a most important physical action on the flocculation and therefore on the tillability of the soil."

MARLS IN OTHER STATES.

As the most extensive use of marls in this country has been in New Jersey, we give the following account of their use in that State. This account is taken principally from reports of the New Jersey Experiment Station:

Greensand marls have been the means of restoring large districts of worn out lands to fertility. The texture

of lands too light to be worked profitably has been improved to such a degree as to make them valuable.

All of these greensand marls contain phosphoric acid in combination with iron or lime, forming phosphates of these substances. These phosphatic compounds are insoluble in water, but are in good form to dissolve in the soil. Phosphoric acid does not occur as a constant quantity, but varies from 1-2 to 4 per cent.—These marls also contain from 5 to 7 per cent. of potash.

Marls whose percentage of phosphoric acid is high have given the best satisfaction in New Jersey. Smaller dressings of this marl usually produce equally as good results as larger applications of other varieties.

There are three varieties of these marls. Those containing large quantities of phosphoric acid; those containing carbonate of lime in fine powder; those consisting of grains of pure greensand.

The phosphoric acid which these marls contain seems to be more available than that in ground bone—and those marls containing small quantities of sulphate of lime are preferred to those which are similar in every other respect, but are wanting in this.

The prices of these marls range from 50 cents to five dollars per ton (20 bushels) according to the distance they have been transported from the pits. They have enriched the favored section in which they occur. They require frequent rains to bring out their fertilizing properties.—The best results from their application are seen on sandy loam soils; soils thoroughly drained are improved to a larger extent than are similar soils undrained.

Marls have also been used in Virginia, the Carolinas and in Georgia, with similar good results. They will pay in Mississippi just as well as elsewhere, provided the best varieties are selected and judiciously applied.

OCCURRENCE OF MARLS IN MISSISSIPPI.

From the Geological Report of Dr. Eug. W. Hilgard, we cull the following in regard to the occurrence of marls in this State. They are classified as occupying essentially four different positions, viz:

1. Cretaceous marls in the North-Eastern Prairie region.
2. Marine Tertiary marls occurring in the Central Prairie region.
3. Clay marls interspersed in patches in beds of the different clays throughout the entire region South of the Central Prairie belt.
4. The calcareous silt which forms the main portion of the hills in the Southern counties are classed as fresh water marls.

We dismiss the two latter classes with this notice of their occurrence.

All of the many varieties of the Cretaceous marls may be embraced under the heads of greensand marls, clay marls and greensands. The greensand marls occur in Tippah, Pontotoc, and Chickasaw. The clay marls of this formation belonging to the Rotten Limestone age, occur in Tishomingo, Itawamba and Pontotoc. The greensands occur in Monroe and Lowndes Counties.

Table 1 gives analyses of marls from this region. In connection with those that have been made in this laboratory, a number of analyses that were made by Dr. Hilgard and published by him in the Tenth Census Reports above referred to, are also given. We have taken the liberty to assign letters to the different analyses made by Dr. Hilgard; those made in this laboratory were made by Dr. B. von Herff, and are given with the station numbers.

MARLS OF THE CENTRAL PRAIRIE REGION.

Underlying the greater portion of this belt which extends across the central portion of the State are various kinds of marls. Their agricultural value is quite variable. The clayey varieties occur chiefly in the Northern portion. The sandy or purely calcareous varieties are found near the Southern edge.

Table II gives analyses of marls of this section.

[TABLE I.]

LOCALITY, DESCRIPTION, OCCURRENCE, Etc.	Station Number.	Insoluble Matter	Carbonate of Lime,	Phosphoric Acid	Potash	Magnesia	Sesquioxide of Iron & Alumina
GREENSAND SHELL MARL, from Sec. 22, T. 4, R. 3 E, 2 miles west of Ripley, Tippah County, crops out in the bed of a small creeek	A	48.819	21.765	....	1 342	2.383	18.510
BLUE MARL, from a well in the town of Ripley, similar marls crop out at numerous localities in this region.	B	62.441	14.154	.226	703	1.560	17 714
INDURATED BLUE MARL, from Sec. 21, T 3. R. 4 E. Tippah County. Somewhat difficult to crumble. For use it should be exposed to the weather for some time	C	40.855	38.084	.292	.154	.910	12 367
BLUE MARL, from a place southeast of Ripley, exact locality not given. This marl is said to fairly represent most of those occurring in the eastern part of the marl region of Tippah and Union	D	78.842	11 701	.180	.797	1.445	5.618
BLUISH GREENSAND MARL, from an outcrop 1 mile south of Pontotoc, Pontotoc county,; several feet in thickness; easily accessible	E	49.051	28.919	.199	1.701	1.091	16.055
ROTTEN LIMESTONE, from near Okolona, Chickasaw County, a fair sample of the white "Prairie Rock".	F	10 903	81.501	....	.248	.877	3.378
YELLOW CLAY MARL, from railroad cut southeast of Chewalla station, Alcorn County	G	55.554	23.66	144	557	1 314	13.210
GREENISH MICACEOUS SAND, from a bluff on the Tombigbee River near Aberdeen, Monroe County	H	81 224	8.768	131	.765	824	7 372
GREENISH MICACEOUS SAND, from a bluff on the Tombigbee River near Waverly, Lowndes County	I	88 702	2.402	.328	.204	.723	5 598
GREENSAND, from Columbus, Lowndes County	38	34.95	49.60	.070	.370	2 970	9 42
PHOSPHATIC MARL, from Columbus, Lowndes County	39	57.55	31 32	2 06	.500	1 350	7.50
MARL from Plymouth Bluff Lowndes County	28	36.73	44 93	.12	.390	2.560	10.43
GREENSAND from Shuqualok, Noxubee County	31	4.98	90 30	59	.090	1.20	2.70
SHELL MARL from Senator Boon Boonville, Miss	30	52.81	4 60	.42	151	3.90	29.00

LOCALITY, DESCRIPTION, OCCURRENCE, Etc.	Station Number.	Insoluble Matter.	Carbonate of Lime.	Phosphoric Acid.	Potash.	Magnesia.	Sesquioxide of Iron & Alumina.
YELLOW CLAY MARL, from the Chickasawhay River, Sec. 31, T. 1, R. 16 E, about 30 feet in thickness	J	39.11	36.18	.9	.436	1.601	9.887
YELLOW CLAY MARL, from Moody's Branch, near Jackson, Hinds County, 20 to 40 feet in thickness, near the city	K	37.4	51.30	.256	.445	1.407	5.133
WHITE MARL, from a farm 4 miles southeast of Brandon, Rankin County	L	13.07	82.63	[illegible]	.265	.614	2.722
YELLOW FRIABLE MARL, from Sec. 3, T. 10, R. 1 W. on the Chickasawhay River	M	17.97	69.42	.223	.321	.940	8.773
BLUE GREENSAND MARLS occur together in the banks of Garland's Creek, on Sec. 21, T. 1, R. 16 E, Clarke County N is a bed about 2 feet thick. It overlies the bed O, which is five feet thick, The first is a greensand shell marl rich in phosphoric acid and potash; the second is almost destitute of phosphates	N	45.88	26.32	.327	1.717	2.476	20.771
	O	38.22	50.13	.069	.978	1.482	8.228
BLUE MARL, Smith's bridge, Warren County	P	31.22	53.75	.038	.858	1.704	7.531
BLUE SHELL MARL, from the bluff at Vicksburg, midway down the face It is about 5 feet thick	O	20.97	67.83	.135	.755	2.082	4.722
BLUE MARL, from the bed of Chickasawhay River, at the mouth of Limestone Creek, Wayne County	R	56.79	37.01	.121	.369	.830	2.783
BLUE SHELL MARL, from the bed of Shongalo Creek, near Austin's Mill, about two miles north of Raleigh, Smith County	S	62.22	23.50	.150	.170	2.858	5.375
MARL from Sec. 30, T. 4, R. 7 W, Wayne County	32	30.17	36.04	.13	.24	3.10	22.50
" " Sec. 3, T. 8, R. 7, W, " "	36	42.75	41.59	.17	.42	3.4[illegible]	9.05
" " Sec 3, T. 8, R 7, W, " "	23	50.64	34.30	.12	2.27	3.45	5.83
" " Sec. 12, T. 10, R 6, N.E, Wayne County	29	56.76	31.18	.08	.50	1.49	5.20
GREENSAND from Garland's Creek, Clarke County	35	75.50	3.44	.15	.62	2.70	12.19
MARL from Chunky Station, Newton County	33	64.80	9.18	.16	1.15	3.95	12.90
" " " " " "	34	63.25	8.49	.19	1.12	5.15	16.65
" " " " " "	25	48.44	13.59	.23	1.92	5.19	22.85
" " Smeder's Bluff, Warren County	24	26.65	52.30	.17	.06	7.91	8.15
" " " " " "	22	32.12	47.50	.18	1.59	5.55	9.82
" " Mint Springs Bayou, Warren County	27	34.15	44.66	.19	1.03	2.78	11.38
" " " " " " "	26	19.44	43.80	.59	.92	7.08	22.13
" " Edwards, Hinds County	21	18.09	54.00	.15	.68	6.79	12.75
" " Heidelberg, Jasper County	32	30.17	36.00	.13	.24	3.10	22.50

An examination of the tables of analyses shows that the best marls in the Cretaceous or North-Eastern Prairie region are to be found in the Pontotoc ridge. Yet in all the counties in which marls occur there are some that can be profitably used, while there are others that would not pay for the expense of even the shortest transportation. The surest way in the selection of any marl for use would be to have it analyzed.

What has been said in regard to the Cretaceous marls will apply to the marls of the Central Prairie region.—Doubtless the poorer qualities in this belt are to be found in Smith and Wayne counties. The "sour" lands South of this belt would be greatly improved by the application of marls. The quantity to be used may vary from 10 to 25 tons (200 to 500 bushels) per acre; and it is usually desirable to accompany an application of marls with the incorporation of vegetable matter, which may be accomplished by plowing under a crop of pea vines, or even of weeds.

Where marls of good quality are to be had for the hauling, as is the case in some portions of the State, they are the most economical fertilizers which can be used—but as so large a proportion of those found in this State contain small quantities of the valuable ingredients, we do not recommend their indiscriminate use.

Potash is worth about 5 and phosphoric acid 8 cents per pound; with these figures it is easy to estimate the value of these elements per ton in the marls enumerated above.

We shall be glad to receive samples from other sources where they are found in sufficient quantities to be of general interest. Analyses of such will be made, free of charge, provided samples are sent in a proper form. A sample for analysis should weigh about two pounds, and must be accompanied by a statement giving exact location, township, range and section, the thickness of the bed, its depth from the surface of the ground, and, if possible, its area.

Send samples by Express, to

EXPERIMENT STATION,
Starkville, Miss.

☞ [Copies of this Bulletin will be sent free to all farmers in Mississippi who apply for it.]

MISSISSIPPI

AGRICULTURAL EXPERIMENT STATION.

BULLETIN, NO. 5.

Fertilizers.

S. M. TRACY, Director

AGRICULTURAL COLLEGE, MISS.

MAY 20, 1889.

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The bulletins of the Station are sent, free of charge, to all persons in this State who apply for them.

THE USE OF FERTILIZERS.

Bulletin No. 3 of this Station gave the Fertilizer Law of the State and analyses of such feltilizers as are sold in the State. The aim of the present bulletin is to give some facts in regard to the most economical use of fertilizers, both natural and artificial. Some of the facts given are the results of work done at this Station, while others have been collected from various sources which are inaccessible to the majority of farmers. While the bulletin contains little which is new, we believe the facts and principles given to be of sufficient importance and general interest to warrant the Station in publishing them in the present form.

A fertilizer is a substance, which, when applied to a soil, will enable the soil to produce an increased crop.

If it were necessary for a fertilizer to contain all the food needed for plant growth, fourteen elements would be necessary to make it complete, but as most soils contain an abundance of eleven elements, a fertilizer needs to contain only the three which are usually deficient, viz: Nitrogen, potash, and phosphoric acid.

It is true that a chemical analysis of almost any soil will reveal the presence of a sufficient amount of these three to produce a large number of heavy crops, but unfortunately, such an analysis will show nothing of their condition or availability, and hence is of very little value in determining the kinds and amounts of fertilizers needed for a given field. This is especially true of the phosphoric acid, which combines very readily with the iron in the soil, and so becomes insoluble and unavailable for plant food. All the food of plants is absorbed in either a liquid or gaseous form, so that, even if the plant food be present in abundance, it cannot be used by the plant unless it is in a form in which it can be dissolved in water, or in some of the very weak acids found in the soil. Insoluble food is of no more value to a plant than is raw iron ore to a manufacturer of watch springs. The plant must not only have an abundant supply of food, but this food must be in such a mechanical and chemical condition as to be available to the plant during the few weeks in which it is making its growth. However rich a soil may be in available plant food, we need not look for a good crop if the ground is so hard and lumpy that it cannot be penetrated by the roots, and it is useless

to apply any fertilizer which contains plant food locked up in an insoluble form; so that, whatever crop we may attempt to grow, or whatever fertilizer we may apply, a thorough pulverization of the soil is essential to success.

We have on record 110 analyses of soils from various portions of the State. Estimating that six inches in depth of soil from an acre weighs 2,000 000 pounds, we find that an average of these soils contains per acre:

Potash.....6,060 pounds.
Phosphoric Acid.....2,190 pounds.
Nitrogen.....3,680 pounds.

A crop of 750 pounds per acre of seed cotton removes from the soil:

Potash.....8.50 pounds.
Phosphoric Acid.....7.20 pounds.
Nitrogen.....25.25 pounds.

At this rate, the average Mississippi soils contain a sufficient amount of these ingredients to last:

Potash.....750 years.
Phosphoric Acid.....304 years.
Nitrogen.....158 years.

From this it is at once seen that absolute soil exhaustion, so as to make our soils truly barren, is practically impossible, especially if the cotton seed be restored to the soil, but as the amount of these ingredients which is in a condition to be available to the plant is usually less than one per cent. of the amount present, it can be readily seen that for continued cropping, it is necessary either to add to the amounts already in the soil, or to so change that which is present as to prepare it for use. The whole question of fertilizing thus resolves itself into a consideration of which of the two methods we can pursue at the lesser cost.

Lime is the only substance known which can be applied cheaply, and which will render the insoluble plant food available, and even this is quite limited in its effects. Upon most soils it acts favorably for a time, but soon loses fts power, and if applied too frequently, renders the soil less productive than before. On nearly all soils, therefore, it will be found most economical to add the necessary elements directly, rather than to depend entirely upon an unreliable disorganizer.

Fertilizers may be classed as (1) Natural, and (2) Chemical. Natural fertilizers include stable manure, cotton seed in its various forms, green crops, and marls. Of these, stable manure is by far the most valuble for general use, as it contains all the elements needed for plant growth in a condition in which they are soon available; and in addition, its principal bulk is composed of humus-making material which is needed for all excepting very fresh or alluvial soils.

Although stable manure is always regarded as a "complete" fertilizer, and is a standard with which others are compared, it is of very variable composition and value, its composition being determined by the animals from which it comes, their food, age and condition, the amount of straw and bedding which has been mixed with their droppings, whether it has been sheltered or exposed to leaching rains, the length of time since it was made, and by many other causes. A ton of ordinary stable manure with the usual proportions of droppings and litter contains about eleven pounds of potash, five of phosphoric acid, and twelve of nitrogen, available for plant food, but we find many samples varying widely from these amounts though the proportions remain about the same.

In estimating the value of such manure it should be borne in mind that in no case does the manure contain more plant food than did the food fed to the cattle which produced it. A ton of wet and dirty straw is worth no more as a fertilizer than is the same amount of dry straw, and if a milk cow is fed with straw alone her manure will be worth less than the straw by just the amount of potash, phosphoric acid and nitrogen which has been taken out of it for the production of milk. By passing food through an animal we add nothing to its manurial value excepting as it is ground up and softened by digestion so that it will decay more rapidly when spread in the field. When food is eaten by an animal very little of its manurial is lost, the ingredients assimilated in digestion being principally the carbonaceous and fatty portions which are of little or no value as fertilizers. Reckoning potash to be worth five cents a pound, phosphoric acid seven cents, and nitrogen seventeen cents, if a steer is fed on straw alone and neither gains nor losses flesh during the time of feeding, the manure will contain, according to Wolff:

Potash	.575	per cent.	worth per ton	$ .565
Phosphoric Acid	.270	"	"	.378
Nitrogen	.320	"	"	1.088
Total value				$ 2.031

If clover hay be used in the place of straw, the value will be as follows:

Potash	2.311	per cent	worth per ton	$ 2.311
Phosphoric Acid	6.63	"	"	.928
Nitrogen	5.92	"	"	2.013
Total value				$ 5.252

According to the same authority the value of the manure from a ton of a ration mixed in the proportion of twenty pounds of ordinary hay and eight of cotton seed meal will be $12.54; if in the proportion of twenty pounds of hay and eight of corn it will be $6.49; if in the proportion of twenty pounds of clover and six of corn it will be $8.95; if in the proportion of twenty pounds of

clover hay and five pounds of cotton seed meal it will be $13.29.

The values given above are for the excrement only and when mixed with litter, cornstalks and weeds, or if the urine is permitted to be lost, the value per ton of what is hauled to the field will be correspondingly less.

From these statements it is seen that the value of a ton of barnyard manure may vary greatly even if we consider only that part of it which is composed of animal excrement. As a matter of fact such manure is always mixed with a greater or less amount of straw, cornstalks and other litter which add bulk and weight, but very little to its fertilizing value. The differences in value are really greater than indicated above, as the figures given are for the values in the barn-yard, and in estimating its value in the field the cost of hauling must be deducted from the value in the yard. The cost of hauling and spreading a ton of poor manure is the same as that for the same amount of good manure, and if we estimate this cost at twenty-five cents per ton it will make the field value of manure from straw alone only $2.08, while that from a better ration, say twenty pounds of clover to five pounds of cotton seed meal, will be $13.04 Good feed for stock pays, not only in the better growth of the animals, but also in the greatly increased value of the manure; and it will usually be found that a ration which will produce the cheapest beef will also give the best manure.

When stock is fed so as to secure the most rapid growth from a given expense for feed, and so as to make the best manure, it is still an important matter to know how to care for and to handle the manure to the best advantage.

As the most valuable parts of the manure are the urine and the soluble portions it is evident that it is very poor economy to take it out of the stable and expose it to the weather in heaps about the yard. With continued rains the fertilizing elements will be largely washed away, while, if the weather is dry, the heaps will soon heat and drive off a large portion of the nitrogen in the form of ammonia. In order to retain its original value the manure must be preserved both from leaching and from heating. This may be accomplished in several ways. Where neat cattle alone are fed it is a very common practice to allow the manure to accumulate in the stalls during the whole feeding season, or until it becomes so deep as not to leave room for the stock. This is an excellent plan provided sufficient bedding is given to absorb the urine and keep the stalls dry. All the excrement is saved, and when kept trodden down in such a compact mass there will be no heating. Horse manure cannot be kept long in this way, as it heats more readily and if left undisturbed will very soon begin to give off the characteristic pungent odor which indicates the escape of ammonia. If but few horses or mules and a larger number of neat cattle are kept, the horse manure can usually be kept unchanged by mixing it with that in the cattle

stalls and allowing the cattle to tramp it all together. Where the stables have wooden floors, or for any other reason it is not desirable to let the manure accummulate in the stalls, a shelter should be provided so that it need not be exposed to the rain. A cheap and convenient shelter may be made by digging a pit three or four feet deep, throwing the dirt to the sides so as to make them about two feet higher than the level of the yard. Make the pit twenty-five by forty feet, and slope the ends so that a wagon can be driven through it. Cover the pit with a roof of rough plank extending two feet beyond the sides, and high enough not to interfere with driving through. Run a single line of plank from the stable door to this pit, and the manure can be wheeled out daily and thrown in with very little trouble. In this way, the urine can all be saved with the other manure, and the heap will be kept so moist that there will be little danger from heating. If the bottom of the pit is of well tramped clay, there will be almost no loss from leakage, and should the heap have a large proportion of horse manure, heating may be prevented by occasionally pumping the urine over the heap, but this will sel dom be necessary. A pit similar to the one described is in use at the Station barns, and holds all the accumulations from about eighty cattle and fourteen mules during four months. So far, we have had no trouble from heating. There will always be more or less manure scattered about in the yard, and this, together with the refuse feed, mouldy hay or grain, blood, hair, and entrails from butchering, and other waste material should be thrown into the pit with the manure. If hogs are kept where they can have access to the pit, they will secure a considerable amount of food from it, especially if the cattle are fed with whole corn, and will add largely to its value by their own droppings, and by keeping it so thoroughly stirred as to prevent heating.

When in such a pit, the manure undergoes a slow process of decay in which there is but little loss There is also a considerable evaporation of water, which makes the manure lighter and less bulky for hauling, and more available for the immediate use of the crops to which it is applied. While the two methods of keeping manure which have been described are the best economy, there are many farms on which it is not convenient to practice either, and the manure must be left exposed to the weather from the time it is taken out of the stable. In such cases it is usually best to haul and spread it on the field at once, and then plow it under as soon as the condition of the ground will permit. When spread on the field, there will be no loss from heating, and nearly all of the soluble matter which is washed out by the rains will find its way into the soil, and be retained near the surface. Clay absorbs impurities from water much more readily than sand, so that if the manure is to be left exposed for a considerable time, it should be put on those fields having a clayey rather than a sandy soil. Heavy clay soils are improved mechanically by the

use of coarse and fresh manures, while for sandy soils which are already too light, it is better to use the older and finer manures. The custom of hauling manure to the field and leaving it in heaps is seldom good economy, as, if the heaps are large they are almost sure to lose by heating, and in any case, the manure has to be handled a second time. The manure can be spread in but little more time than is needed for dumping it in piles, and the work can be much more easily done from the wagon than from the pile. It is important that the manure be as evenly spread, and as thoroughly mixed with the soil as is possible, and when spread on the ground for some time before plowing, the rains wash out and carry into the soil such a large proportion of the soluble matter, that many recommend this method rather than the immediate plowing under. In most cases, this must be decided by the condition of the soil and the season. If plowed under in the fall, it will become very thoroughly decayed before needed for plant food in the spring, and if it is not hauled out until spring, it must be plowed under at once in order to prepare the land for planting.

In the northern states, where the seasons are short and the period of active plant growth extends over but a few weeks, great stress is laid on the importance of composting manures, and having them thoroughly rotted before using. Here, where the growing season is longer, the rainfall greater, and decay more rapid, composting is of much less advantage, and for ordinary farm crops for which stable manure alone is used, it will seldom pay for the necessary labor. It is true that perfectly fresh stable manure contains a very large percentage of water and a small percentage of soluble plant food; but in composting nothing is added to the value of the manure. It becomes more thoroughly mixed and decay is hastened, so that a larger percentage can be used at once by the plant, its bulk is materially decreased, and it loses a large percentage of water.

Dr. Voelcker, of the Royal Agricultural College, in England, made exhaustive examinations of stable manure of different ages, and different manures, from which he obtained some very interesting figures which are of value in this connection. He found that a ton of fresh stable manure composed of cow, horse, and pig dung, mixed with the straw and litter used for bedding contained:

Water	1,323.4 pounds.
Organic matter	564.8 pounds.
Ash	111.8 pounds.
The organic matter and the ash contained	2,000.0 pounds.
Nitrogen	12.75 pounds.
Phosphoric Acid	6.50 pounds.
Potash	13.50 pounds.
	32.75 pounds.

The value of these ingredients, as valued here, would be:

Nitrogen	$2.30
Phosphoric Acid	.52
Potash	.81
	$3.63

This does not represent the full actual value of the manure, however, as no account is made of the humus-making material, or of the mechanical effect in loosening the soil.

When the manure was in a heap and exposed to the weather, it changed as follows:

	November 3d.	*April 30th.*	*August 23d.*
Fresh	2,000 lbs.	1,428 lbs	1,405 lbs.
Water	1,323 lbs.	941 lbs.	1,061 lbs.
Dry matter	677 lbs.	487 lbs.	344 lbs.
Loss		572 lbs.	595 lbs.

The loss occurring between November and April was in water 382 pounds, and dry matter 190 pounds, the loss in water being a gain in value by the decrease in weight, and the loss in dry matter being principally of organic matter, the manure was worth fully as much in April as in November. It must be borne in mind, however, that while this manure was exposed to the weather, it was so placed that there was no waste from leaching. From April to August there was a loss of 143 pounds of dry matter, of which 3.5 pounds was nitrogen, and an increase of 119 pounds of water, thus making the manure less valuable and more expensive to haul.

When kept under shelter the same length of time, the changes were quite different, as follows:

	November 3.	*April 30th.*	*August 23d.*
Fresh	2,000 lbs.	992 lbs.	800 lbs.
Water	1,323 lbs.	566 lbs.	347 lbs.
Solids	677 lbs.	426 lbs.	433 lbs.
Loss		1,008 lbs.	1,200 lbs.

In this experiment the loss of the water in the first period amounted to more than 37 per cent. of the entire weight, while the loss of dry matter was 251 pounds, or about 12 per cent. This might have been expected, as the heating would drive off a large portion of the moisture, besides causing a more rapid decay of the vegetable matter. When kept until August 23d, there was a still further loss of 213 pounds of water, and of 8.2 lbs. of nitrogen.

The greatest loss occurred when the manure was spread over the surface of the yard, as follows:

	November 3d.	*April 30th.*	*August 23d.*
Fresh	2,000 lbs.	1,730 lbs.	1,226 lbs.
Water	1,323 lbs.	1,385 lbs.	859 lbs.
Solids	677 lbs.	345 lbs.	367 lbs.
Loss		270 lbs.	774 lbs.

In this experiment, the loss in nitrogen, the most valuable element in the manure, was very marked, the amount present being

November 3d ..... 12.9 pounds.
April 30th ..... 9.2 pounds.
August 23 ..... 5.0 pounds.

From these and other experiments, Dr. Voelcker makes the following conclusions:

"The soluble organic and mineral constituents of dung are much more valuable fertilizers than the insoluble. Particular care, therefore, should be bestowed upon the preservation of the liquid excrements of animals, and for the same reason the manure should be kept in perfectly water-proof pits of sufficient capacity to render the setting up of dung-heaps in the corner of fields, as much as it is possible, unnecessary.

"The urine of the horse, cow, and pig, does not contain any appreciable quantity of phosphate of lime, whilst the drainings of dung-heaps contain considerable quantities of this valuable fertilizer. The drainings of dung-heaps, partly for this reason, are more valuable than the urine of our domestic animals, and, therefore, ought to be prevented by all available means from running to waste.

"The most effectual means of preventing loss in fertilizing matters is to cart the manure directly on the field whenever circumstances allow this to be done.

"On all soils with a moderate proportion of clay, no fear need be entertained of valuable fertilizing materials becoming wasted if the manure cannot be plowed at once. Fresh, and even well rotted manure contains very little free ammonia; and since active fermentation, and with it the further evolution of free ammonia, is stopped by spreading out the manure on the field, valuable volatile manuring matters cannot escape into the air by adopting this plan.

"As all soils with a moderate proportion of clay possess in a remarkable degree the power of absorbing and retaining manuring matters, none of the saline and soluble organic constituents are wasted even by a very heavy fall of rain. It may, indeed, be questioned whether it is more advisable to plow in a manure at once, or to let it lie for some time on the surface, and to give the rain full opportunity to wash it into the soil.

"Cart the manure on the field, spread it at once, and wait for a favorable opportunity to plow it in. In the case of clay soils, I have no hesitation to say the manure may be spread even six months before it is plowed in, without losing any appreciable quantity in manuring matter.

"I am perfectly aware, that on stiff clay land, farm-yard manure, more especially long dung, when plowed in before the frost sets in, exercises a most beneficial action by keeping the soil loose, and admitting the free access of frost, which pulverizes the

land, and would, therefore, by no means recommend to leave the manure spread on the surface without plowing it in. All I wish to enforce is, that when no other choice is left but either to set up the manure in a heap in a corner of the field, or to spread it on the field, without plowing it in directly, to adopt the latter plan. In the case of very light sandy soils, it may perhaps not be advisable to spread out the manure a long time before it is plowed in, since such soils do not possess the power of retaining manuring matter in a marked degree. On light sandy soils, I would suggest to manure with well-fermented dung, shortly before the crop intended to be grown is sown.

"Weight for weight, rotted dung is more valuable than fresh.

"In the fermentation of dung, a very considerable proportion of the organic matters in fresh manure is dissipated into the air in the form of carbonic acid and other gases.

"Properly regulated, however, the fermentation of dung is not attended with any great loss of nitrogen, nor of saline mineral matters.

"Ammonia is not given off from the surface of well compressed dung-heaps, but on turning manure-heaps, it is wasted in appreciable quantities. Dung-heaps, for this reason, should not be turned more frequently than absolutely necessary.

"No advantage appears to result from carrying on the fermentation of dung too far, but every disadvantage.

"Farm-yard manure becomes deteriorated in value, when kept in heaps exposed to the weather, the more the longer it is kept.

"If the rain is excluded from dung-heaps, or little rain falls at a time, the loss in ammonia is trifling, and no saline matters, of course, are removed; but, if much rain falls, especially if it descends in heavy showers upon the dung heap, a serious loss in ammonia, soluble organic matter, phosphate of lime, and salts of potash is incurred, and the manure becomes rapidly deteriorated in value, whilst at the same time it is diminished in weight.

"Well-rotted dung is more readily affected by the deteriorating influence of rain than fresh manure.

"Practically speaking, all the essentially valuable manuring constituents are preserved by keeping farm yard manure under cover.

"The worst method of making manure is to produce it by animals kept in open yards, since a large proportion of valuable fertilizing matters is wasted in a short time; and after a lapse of twelve months, at least two-thirds of the substance of the manure is wasted, and only one-third, inferior in quality to an equal weight of fresh dung, is left behind."

COTTON SEED.

When stable manure is not available, cotton seed in some form is an excellent substitute. Its composition varies somewhat with the season and soil where grown, but for all practical purposes may

be regarded as containing per ton, one thousand pounds of hulls and one thousand pounds of kernels. From the kernels about three hundred pounds of oil may be obtained, leaving seven hundred pounds of meal. The whole seed, hulls, and meal contain about

	Nitrogen.	*Phosphoric Acid.*	*Potash.*
Whole Seed	2.8 per cent.	1.4 per cent.	1.14 per ct.
Hulls	.7	.7	.88
Meal	7.	3.	2.

With that composition the pounds per ton of each element will be

	Nitrogen.	*Phosphoric Acid.*	*Potash.*
Whole Seed	56.	28.	22.8
Hulls	14.	14.	17.6
Meal	140.	60.	40.

The values of these elements at present prices are

	Nitrogen.	*Phosphoric Acid.*	*Potash.*	*Total.*
Whole seed	$10.08	$1.96	$1.14	$13.18
Hulls	2.52	.98	.88	3.38
Meal	25.20	4.20	2.00	31.40

The Station purchased this season at the following prices, viz:

Cotton seed	$ 7.20 per ton.
Hulls	4.00 per ton.
Meal	19.00 per ton.

At these rates nineteen dollars will purchase

2.6 tons of seed, worth	$33.27
1 ton of meal, worth	31.40
4.75 tons of hulls, worth	16.06

Such purchases will give

Profit on purchase of seed	$14.27
Profit on purchase of meal	12.40
Loss on purchase of hulls	2.94

These figures, however, must not be taken as meaning that it is better in all cases to buy cotton seed instead of meal, but rather, the comparative benefits to be expected from each *when used under the most favorable circumstances.* For some crops, and on some soils, the meal will be much the cheaper fertilizer. All animal and vegetable fertilizers contain a greater or less amount of organic matter, or humus-making material, which is of great value to barren or exhausted soils, but which will be of no benefit, and may sometimes be actually a detriment to creek bottom lands, newly cleared timber land or to other soils, which are already supplied with black humus Heavy clay soils ordinarily contain a fair amount of plant food, but are usually deficient in humus, and are so compact and solid that they cannot be easily penetrated by roots, nor will they admit of the rapid percolation of water, which is essential to a productive soil. On such soils, seed will be much more valuable than meal, both on account of its greater fertilizing

and humus-producing properties, and also on account of its mechanical effect in making the soil lighter, more porous and friable, more easily worked, and less liable to bake after heavy rains. The seed will not act as quickly as the meal, neither will it be exhausted so soon; a large proportion of it, especially of the hulls, remaining in the ground until the second year. On land which is to be permanently cropped, there will be no loss, its mechanical effect in loosening the soil more than making up for the small amount which may be lost by leaching.

The form in which the seed is used will influence the rapidity of its action. It must decay and become soluble before it can be used as plant food. If fresh seed is used, this will require some weeks; if the seed is killed by wetting and heating, the process is hastened; but if the seed is crushed, it will be ready to act still more quickly.

When a stimulating fertilizer is wanted to push a crop forward rapidly for a short time only, the meal is better than even crushed seed, as it decomposes so rapidly as to become almost immediately available, and will produce its entire effect within a very few weeks. On very light and sandy soils which are already sufficiently loose and friable, or when the soil is underlaid with gravel so as to leach badly, meal is more economical than seed.

As will be seen from the analysis on a preceding page, cotton seed hulls have but little fertilizing value, and as a fertilizer alone they do not pay at the prices quoted. Where the main object of an application is to loosen a too heavy soil, or a mulch is wanted to protect tender plants, strawberries, etc., the hulls are useful, but are worth more to use as stock food than to use on ordinary crops. Hull ashes, as usually found in the markets, contain about nine per cent. of phosphoric acid and twenty pounds of potash, making their value $32.60 per ton. As usually found in the market, they are more or less mixed with coal ashes, but we have never examined a sample which was not well worth the price asked—usually about $20.00 per ton. In the immediate vicinity of oil mills, seed is often worth more, and hulls less than the prices given above, so that often the use of hulls will be found more economical than the seed.

GREEN MANURING.

Green manuring, or the plowing under of green crops, is beneficial in two ways: First, by practically giving the soil a rest for a year; and second, by increasing the amount of available plant food. As stated on a preceding page, nearly all soils contain an abundance of plant food to produce a full yield of almost any crop, but most of this food is in an unavailable condition. This insoluble matter is acted upon differently by different plants, each kind of plant taking certain elements and leaving others in a condition in which they are ready to be absorbed by some other kinds of plants. The beneficial effects of crop rotations depend

on this principle, and the crops commonly used for green manuring are not those cultivated for other purposes. By using special crops for green manures, the plants find an abundant supply of food which has been rejected by the farm crops, and so can make a vigorous growth where regular crops would fail. The materials which they take up from the soil and from the air, they do not remove from the field, but by their decay in the soil they leave available for future crops not only the elements of which they themselves are composed, but also those which have been rendered available by the root action of the manurial crop. In addition to this, they leave in the soil nearly their whole weight in humus-making material.

The most valuable crops for green manuring are those which have the deepest roots, as such will draw up from the subsoil a large proportion of their mineral food, which, when the crop is plowed under, is left near the surface, where it is available for such shallow-rooted plants as oats, corn, and grasses. In decaying, the deep plant roots leave minute openings in the subsoil, which are valuable aids in making the subsoil porous and permeable to water.

The plants commonly used for green manuring in this State are pea vines and red clover. In 1887 Prof. Myers, the former Chemist of the Station, made complete analyses of these plants, together with an analysis of Japan clover (*Lespedeza striata*), with the following results, viz:

PLANT.	Pounds.	Phosphoric Acid, lbs.	Potash, lbs.	Nitrogen, lbs.	Value.	Total value.
Pea vines—tops	2,000	10.959	15.01	46.36	$ 9.40	
Pea vines—roots	522.1	2.285	5.29	8.28	1.83	$11.23
Lespedeza—tops	3,523	14.16	18.92	72.93	14.34	
Lespedeza—roots	1,442	30.43	15.27	16.78	5.75	20.09
Clover—tops	1,202	82.21	8.72	36.99	12.48	
Clover—roots	642	5.02	2.38	13.96	2.84	15.32

In the figures given above, those for lespedeza roots are the average of two analyses, and those for clover are from plants taken in October, which were only eight months from seed. Prof. Myers says: "The peculiarity of the growth of the cow pea precludes the possibility of arriving at much idea of the actual rate of production by washing out a few square feet. In this case I have, therefore, found the ratio of root to top, which in the samples examined was 1 to 3.83. I then calculated the composition upon the yield of 2,000 pounds of tops to the acre."

The table is somewhat misleading, as the pounds per acre for each plant do not fairly represent the average yield of the respective crops. The pea vines and clover are too small, and the lespedeza too high. If we make an estimate on a crop of two tons per acre for pea vines and clover, and one ton for lespedeza, we shall be nearer the ordinary values. The table will then read as follows :

PLANT.	Pounds.	Phosphoric Acid, lbs.	Potash, lbs.	Nitrogen, lbs.
Pea vines—tops	4000	21.918	30.04	92.72
Pea vines—roots	1044	25.70	10.58	16.56
Lespedeza—tops	2000	8.04	10 74	41.40
Lespedeza—roots	819	17.28	8.67	9.53
Clover—tops	4000	273.58	29.01	123.10
Clover—roots	2136	16.70	7.91	46.45

By this showing, clover becomes the most valuable crop of the three, which accords with the general experience. There are two reasons for this: First, because the clover contains the largest percentage of nitrogen, which is the most expensive element in plant food; and second, because it is deeper rooted, and so brings a larger proportion of its food from the subsoil, where it is inaccessible in other plants. The common saying, that "clover seed is the cheapest fertilizer," has a solid foundation.

The value given above must not be taken as actual, but as being comparative only. That is, if it would cost $11.23 to purchase the fertilizing elements in the tops and roots of the acre of pea vines, then it would cost $20.09 to buy the amount of these same elements found in the acre of lespedeza, and $15.23 for those in the acre of clover. The nominal value of these green manures is far above their actual value, from the fact that all the fertilizing elements are valued as being immediately available for the succeeding crops, while as a matter of fact, an indefinite proportion may not be available for a long time, and some of the plant food is in such excess that it cannot be consumed.

The Experiment Station of the Storrs School, in Connecticut, as given in bulletin No. 3 of that Station, has made some interesting and very useful examinations of the amount of roots of plants found at different depths in the soil. From the report, it would appear that the amount has an important bearing on the value of different crops for enriching the land on which they grew. Clover appears to stand far above all others, for in addition to the mechanical benefit of its roots, it was found that the roots

and stubble—that is, what is left after the mowing—contain large percentages of the three most valuable ingredients of plant food, and at the same time a large amount in quantity is left in the soil. In one instance, a heavy crop left a little over three tons of dry stubble and roots, containing 180 pounds of nitrogen, 71 of phosphoric acid, and 77 pounds potash. The report of the Station states that it would require 1,100 pounds of nitrate of soda, 400 pounds of dissolved bone-black, and 150 pounds of muriate of potash, to furnish the same amount of fertilizing materials; but these materials would, however, have the advantage of being used at once by the growing plants, and before the decaying roots and stubble could supply them. Wheat and other grain crops, as a class, were found of little value for enriching the land by their roots. Timothy—stubble and roots together, with the young after-growth—was found to possess much enriching value, which was mostly confined quite near the surface. In the cow pea, three-fourths of the roots were within six inches of the surface, although a portion went down more than three feet. In timothy, the difference in favor of six inches of the surface was still greater, and greater still with buckwheat, where the upper six inches of the soil held 25 times as much of the roots as the next six inches.

The objection sometimes urged against green manuring is that if the crop is plowed under in the fall, it leaves the ground bare and subject to washing and leaching during the winter. This objection has force on broken and hilly lands only, and even there may be avoided by plowing so early that a crop of weeds will have time to cover the ground before cold weather.

Stable manure, which has been produced on the farm, is the cheapest and best fertilizer for all ordinary crops, because it is a waste product, but when the supply of this is insufficient, resting the land and plowing under some deep-rooted crop will, in many cases, be the cheapest method for keeping up the fertility of the soil.

MARLS.

Bulletin No. 4, of this Station, gives analyses of marls found in Mississippi. It will be seen, that while of general occurence throughout the State, very few of the marls are rich enough in phosphoric acid and nitrogen to make them sufficiently valuable to pay the cost of long hauling. The best specimen we have received is from Wayne county, Section 3, Township 8, Range 7 west., which is valued at $2.34 per ton, and the next best is from Chunky Station, Newton county, valued at $2.24 per ton. None of the Mississippi marls, so far as known, contain over 2.06 per cent. of phosphoric acid, which is found in a sample from Columbus, in Lowndes county. In some of the soils in this State, phosphoric acid and nitrogen are needed more than potash, so that in such cases it will often be found that a marl rich in

phosphoric acid and poor in potash may be more beneficial than one of which the total value is made up largely from its potash.

If the beds are near at hand, it will be profitable to haul marl for use on creek bottoms and "sour" soils, when the teams are not otherwise employed, but there are few cases in which it will pay for hauling more than two or three miles. From ten to twenty wagon loads should be used per acre, and its effect will be increased if applied to the land just before plowing under some green crop. If this is impracticable, it will be improved by adding half a ton of ashes per acre. In estimating the values of marls, no account has been made of the large percentage (usually 40 to 60 per cent.) of lime which they contain, because that element is usually abundant in most of our soils; but whenever lime is wanted it can be well replaced with marl.

COMMERCIAL FERTILIZERS.

The economical use of commercial fertilizers is one of the most difficult problems with which we have to deal, as in many cases they are the cheapest fertilizer which can be obtained, while in other cases, the money paid for them might as well be thrown away. They may contain the three necessary elements of plant food in some definite proportions, but it is so seldom that a particular crop and field require these elements in exactly the proportions in which they are found in any one of the staple brands, that it is difficult to decide which it is best to purchase. While it is a simple matter to make an analysis of a soil, and of the crop which we may wish to grow upon it, these analyses tell us little as to what may be the best fertilizer for us to use. The analysis of the soil does not tell us its condition, whether the plant food it contains is in an available form, or anything of the mechanical condition of the soil. Plant food in the soil may be available for one plant while it is not so for another, and, for some reason which we are unable to explain, most plants grow best in a soil containing certain available elements far in excess of the amounts consumed in growth. It is known that an abundance of nitrogen is necessary to produce a vigorous growth, that potash is necessary for the production of the woody parts of the plant, and that phosphoric acid is largely consumed in the production of the seeds; but in order to produce the best results, these elements should be furnished to the soil in different proportions for different plants, and these proportions are by no means those which are found in the plants themselves. What these proportions are, the chemist cannot tell us, and we can learn them only by experiment.

As has been shown on a preceding page, most of the soils in this State are already fairly well supplied with potash, so that, as a rule, it is less needed than are nitrogen and phosphoric acid, and in purchasing fertilizers, some mixture of nitrogenous and phosphoric acid compounds will be found more economical than the complete fertilizers which contain the three elements. Grain

and grass crops are most largely benefited by nitrogenous fertilizers, while peas and similar crops respond more readily to an application of potash. For cotton and corn, a mixture of nitrogen and phosphoric acid will commonly give the best results, but the form in which these can best be applied will vary with the soil, expense, and crop. As a rule, they can be used more economically if mixed with barnyard manure, cotton seed, or meal, than if used alone. Very few of the commercial fertilizers contain any appreciable amount of humus making material, which is so essential to a vigorous plant growth, and so are, to that exent, deficient as a complete fertilizer.

Most commercial fertilizers have phosphoric acid in the form of acid phosphate as a basis. To this is usually added potash in the form of kainit and a small amount of nitrogen in the form of dried blood, fish scraps, leather refuse, or sometimes nitrate of soda, or some other cheap nitrate salt. These are mixed in various proportions according to the "brand" which it is desired to manufacture, and then placed on the market at a price decidedly in advance of the cost of the raw materials, as it should be; the usual estimate of the actual cost of mixing and sacking ordinary brands in New Jersey is $2.85 per ton. In addition to this cost, the manufacturer is entitled to a fair profit for handling the goods, so that by the time the fertilizer reaches the consumer, the price becomes so high that many planters are unable to purchase as liberally as true economy would indicate.

We fully believe that, in all ordinary circumstances where commercial fertilizers are needed, the farmer will find it cheaper to purchase the raw materials and mix them for himself in the proportions best adapted to his particular soil and crop.

Nitrogen can be obtained in the form of nitrates at a cost of about seventeen cents per pound, but if it be obtained from the use of cotton seed, it will cost only 13.6 cents, and from cotton seed meal 14.3 cents; and at these figures no account is made of the value of the potash, phosphoric acid, and humus-making material contained in the seed; which if reckoned in the cost at the usual prices it will bring, would reduce the cost of nitrogen less than ten cents.

Neither the cotton seed nor the meal contains as much phosphoric acid as is needed to make a complete fertilizer, therefore that element must be obtained from other sources. Acid phosphate furnishes it in the cheapest and most available form known, and is the fertilizer which should be purchased more largely than all others. On some soils, an application of this alone will give a profitable increase of crop, but it is more economical to use it as one of the ingredients of a compost, mixing it thoroughly with other fertilizers which contain an excess of nitrogen or nitrogen and potash.

For composts, stable manure is the best possible foundation. If this is stored in a pit, as described on a preceding page, an ex-

cellent mixture for cotton lands can be made by throwing cotton seed and acid phosphate over the pile once a week, or still better every day, in the proportions of one ton of seed and one of phosphate to every four tons of manure. If the heap does not contain too large a proportion of horse manure, it will not heat sufficiently to injure it, and by the time it is to be hauled to the field, the seed will be killed, and in an excellent condition for immediate use by the plant. A ton of such manure will contain 17.67 pounds of nitrogen, 12.80 pounds of potash, and 52.67 pounds of phosphoric acid, and will cost, besides the manure, about $5.43. For soils deficient in potash, the mixture may be improved by the addition of a ton of kainit, which will make the composition of a ton of the mixture contain 15.15 pounds of nitrogen, 45.26 pounds of potash, and 45.15 pounds of phosphoric acid. It is only on a farm where a large amount of stock is kept, that this practice can be followed; where the stable manure cannot be had in sufficient quantities for such a compost, an excellent mixture can be made by using 700 pounds of stable manure, 700 pounds of cotton seed, and 600 pounds of superphosphate. Such a mixture will contain 40 26 pounds of nitrogen, 26.99 pounds of potash, and 61.27 pounds of phosphoric acid. This mixture contains a larger proportion of nitrogen, which is rendered necessary by the absence of the humus-making material contained in the former mixture. With an abundance of decaying organic matter in the soil, nitrification goes on rapidly, and a large amount of nitrogen is absorbed from the air. In the absence of this organic matter or humus, nitrification proceeds very slowly, and more nitrogen must be applied in the fertilizer.

If stable manure is wholly unavailable, and the planter is obliged to purchase all his fertilizers, cotton seed and acid phosphate will produce better results on clay lands than will any form of chemical fertilizer alone, as such soils are always improved mechanically by the use of the seed, and the seed is also the cheapest source of nitrogen. For such a mixture equal weights of seed and acid phosphate may be used, a ton of which will contain 53.2 pounds of nitrogen, 36.4 pounds of potash, and 113 pounds of phoshoric acid and will cost about $16.30. For alluvial soils, less nitrogen will be needed, and the acid phosphate alone or phosphate and kainit may be used with good results.

Chemical fertilizers are valuable only for the nitrogen, potash, and phoshoric acid which they contain. In he purchase of a fertilizer, attention should be given to these only. Acid phosphate is undoubtedly the cheapest form in which we can procure phosphoric acid, and where an abundance of stable manure is not to be had, it will pay to use it freely. Potash can be had most cheaply in the form of kainit. The ammonia in crushed seed or in meal is as readily available as that in most chemical fertilizers, and as the seed is the cheapest source from which it can be obtained, seed or meal should always form a large part of any fertilizer which may

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be used. We do not mean to say that acid phosphate and kainit are the only chemicals which should be used, or that it will never pay to buy any of the "complete" fertilizers found in the market, for under some circumstances, and on some soils, their use will be very profitable, but we do not recommend their indiscriminate use whenever it is thought desirable to manure a field. Such an unthinking purchase of a commercial fertilizer is as wasteful use of money as would be the purchase of "seeds" without knowing what crop we desired to grow. If the dealer kept, and we used but three kinds of seeds, we might, perhaps, receive a kind which would be of value to us, but when one wishes to grow corn, it is wise to buy corn seed for planting. So, too, in buying fertilizers, it is the best economy to buy just what is needed for the particular soil and crop for which it is to be used, and it is a needless waste to purchase plant food which cannot be consumed. It should be borne in mind that for all crops, and for all excepting rich alluvial soils, humus-making material is as necessary as any other ingredient of plant food, and that the use of chemical fertilizers alone without green manuring or resting the land occasionally, will sooner or later reduce the farm to a condition where the return for the crop will not equal the outlay for fertilizers. Where mixed farming is pursued and the manure and cotton seed are all taken back to the fields, and a proper crop rotation is followed, the farmer will have no occasion for the purchase of fertilizers of any kind. Where the farm is managed exclusively for the production of any single crop, except grass, a portion of the fertilizers needed must be purchased. On our large cotton plantations, ammoniated super-phosphate will usually be found the most economical, acid phosphates standing next in value. On such plantations, when the seed is all returned to the field there is but little loss in fertility, but the phosphoric acid will finally become exhausted, and must be replaced in some form. The rich lands in the Delta region of the State have a supply of potash, nitrogen, and humus sufficient for many years to come, and for such lands the phosphates are the only fertilizers needed at present. On the higher lands there is a deficiency of phosphoric acid, nitrogen, and humus, all of which must be frequently renewed.

Whether it is best to use commercial fertilizers broadcast or directly on or under the plants must be decided by the special soil and crop where used, but as a rule, it is more economical to apply them broadcast rather than in the drill. Any one who has seen even half-grown corn or cotton plants from which the soil had been washed, has noticed that the roots had spread entirely across the spaces between the rows, and that near the plants the roots had but few feeding rootlets, while near their extremities, the feeding rootlets were far more numerous; showing that the plants were drawing most of their nourishment from a considerable distance.

When fertilizers are placed under the seed they are often so concentrated that they actually kill the tender rootlets

which come in contact with them. All ordinary seeds contain a sufficient amount of nourishment to sustain the young plants until the roots are several inches in length, as may be seen by planting corn or similar seeds in a box filled with pure sand. The seeds will germinate and the roots will grow to be a foot or more in length as freely as when planted in rich soil.

As has been stated before, roots cannot absorb food in masses, but in solution only, and for this reason it is important to apply a fertilizer in such a manner that it may become thoroughly mixed and incorporated with the soil in which the roots are to feed. Roots possess an almost intelligent power in their absorption of food, and will be developed most abundantly in those parts of the surrounding soil where available food is most abundant. When too concentrated, or in excess, a fertilizer is positively injurious rather than beneficial, while if mixed with the entire mass of the soil within reach of the roots it will induce the increased growth which is desired.

For these reasons it is usually better to apply fertilizers broadcast when but one application is to be made. On sandy soils, or soils which leach badly, it is better to make at least two applications, the first of which may be made in the drill; and it makes but little difference whether it be placed under or over the seed, provided it does not come in contact with it.

For putting commercial fertilizers in the drill we have found nothing better than a corn or cotton planter which can be gauged to distribute any required amount. If applied by hand it will be less evenly distributed, and will often be left in lumps which will be worthless, if not injurious. The second application may be made by hand, or by running a planter in the middle of the space between the rows, and should be followed at once by a cultivator to mix the fertilizer with the soil and preserve it from loss by the action of the air or heavy rains. The fertilizer applied first may be of a less soluble kind than the second application, as the crop has a much longer time for its assimilation. The first application should include the acid phosphates, ground bone, plaster, etc., while the second should be of super-phosphates, kainit, cottonseed meal and other quick acting kinds.

If the fertilizer is applied broadcast it can be distributed more evenly if mixed with a considerable bulk of stable manure or cotton seed to increase its bulk when it can be distributed from a wagon. If that cannot be done, a little practice will enable one to scatter the right amount. A small plot, say a quarter of an acre running the length of the field, should be measured off, and the desired amount of the fertilizer weighed and scattered. Only one or two such trial plots will be necessary to learn just how much should be used in going across the field each time.

There are several machines in the market for the distribution of fertilizers, but we have found none that are better than a corn or cotton planter for sowing in the drill, and a common grain drill for sowing broadcast.

In Great Britain, where nearly all the land is farmed on the tenant system, and where the original fertility of the soil has been long since exhausted by continued cropping, great attention has been paid to the length of time required for the complete exhaustion of different fertilizers, and the amount of each remaining in the soil at the end of each year. According to Scotch estimates, these are as follows:

ON UNCULTIVATED CLAY LOAM.

Kind of Fertilizer.	*Exhausted (in years.)*	*Per cent. remaining in the soil unexhausted at end of each year.*						
		1	2	3	4	5	6	7
Lime	12	80	65	55	45	35	25	20
Bone meal	5	60	30	20	10	00	00	00
Phosphatic guanos	5	50	30	20	10	00	00	00
Dissolved bones and plain superphosphates	4	20	10	5	00	00	00	00
High grade ammoniated fertilizers, guano, etc	3	30	20	00	00	00	00	00
Cotton seed meal	5	40	30	20	10	00	00	00
Barnyard manure	5	60	30	20	10	00	00	00

ON CULTIVATED LIGHT OR MEDIUM SOILS.

Lime	10	75	60	40	30	20	15	
Bone Meal	4	60	30	10	00	00	00	
Phosphate guanos	4	50	20	10	00	00	00	
Dissolved bones and plain superphosphate	3	20	10	5	00	00	00	00
High grade ammoniates, guanos	3	30	20	00	00	00	00	00
Cotton seed meal	4	40	30	20	10	00	00	00
Barnyard manure	4	60	30	10	00	00	00	00

ON UNCULTIVATED PASTURE LAND.

Lime	15	80	70	60	50	45	40	35
Bone meal	7	60	50	40	30	20	10	00
Phos. guanos	6	50	40	30	20	10	00	00
Dis. Bone, etc	4	30	20	10	00	00	00	00
High grade ammoniated guanos	4	30	20	10	00	00	00	00
Cotton seed meal	5	40	30	20	10	00	00	00
Barnyard manure	7	60	50	40	30	20	10	00

Sulphate of ammonia, nitrate of soda, sulphate, nitrate and muriate of potash are generally held to be entirely exhausted by the crops grown the season of their application.

The figures given above are always used in fixing the price for new tenants. In this country, no such careful estimates have been made, but the proportions probably vary but little from those in other countries.

Many complaints are made of the exhorbitantly high prices at which chemical fertilizers are sold. Taking into account the expenses for freights, and sacking, loss on bad debts and interest on

the money invested, there are but few fertilizers which can be sold for less than the prices asked by reputable dealers. During the present season, we have made analyses of forty-three brands. Of these, nine were found to be below the minimum guaranteed value, and only six were up to the highest standard of the limit claimed by the manufacturer, showing very clearly the need of constant and careful supervision by the State for the protection of purchasers, who are obliged to depend almost wholly upon the statements of the dealers. The honest dealer, like any other honest man, intends to give a full equivalent for money received, but unfortunately, there are dishonest dealers as well as ignorant purchasers, so, for the protection of the honest dealer and the ignorant purchaser, the State inspection laws should be sufficiently comprehensive to include both. As the law now stands, purchasers are fairly well protected against fraud on the part of dealers or manufacturers residing in this State, but are afforded no protection whatever against dealers in other States. New Orleans, Memphis, Nashville, and Charleston, probably furnish three-fourths of the fertilizers purchased in this State, and the law should furnish the same protection against fraud in shipments into the State that is afforded against dealers here. Commercial fertilizers are used more largely in Georgia than in any other State, and the laws of that State governing the fertilizer trade are generally regarded as being the best in the United States. Alabama and Louisiana have adopted very nearly the same law on the subject. It has been suggested that all of the Gulf States, together with Tennessee and Kentucky, might agree on some uniform mode of fertilizer inspection which would be a mutual advantage and equal protection to all. It is hoped that our next State Legislature will give the subject the careful consideration which it deserves.

MISSISSIPPI

Agricultural Experiment Station.

BULLETON NO. 6.

CHARBON.

AGRICULTURAL COLLEGE, MISS.,
June 25th, 1889.

On June 10th, information was received at the Station that Charbon had broken out among the mules in the region of Yazoo City; telegrams stating that ower fifty deaths had occurred already, and that all animals attacked died within twenty-four hours. The acting Veterinarian of the Station, Dr. G. C. Creelman, was sent to the infected locality at once, and within a few days the Station had also secured the assistance of Dr. Wray of the U. S. Department of Agriculture, and Dr. Connoway of the Missouri Station.

The work of the latter is not yet completed, but as the disease seems likely to spread somewhat widely in the swamp region of the State, it is thought best to publish the following treatment which has been almost uniformly successful when used promptly, and also to indicate the common symptoms of the disease.

PREVENTIVE TREATMENT.—All animals should be kept in a cool place and protected from flies and other insects, When at work, care should be taken that they are not over-heated, and on returning from the field at night, they should be washed all over with a solution consisting of one part crude carbolic acid to twenty parts water. One bucket full of this will bathe five animals. Give internally one tablespoon full of a mixture containing equal parts of sulphur, saltpetre, and cotton seed meal. This should be given in the food three times a day.

SYMPTOMS OF THE DISEASE.—Usually for some hours before the disease is manifested externally, the animal will appear languid, the ears droop, and signs of general depression may be noticed. The temperature often rises as high as 104 F. and small swellings often make their appearance in the region of the breast, belly or throat. These swellings, if not checked, continue to enlarge until the animal dies.

TREATMENT.—When the first symptoms are noticed, the animal should be drenched immediately with the following: One tablespoon full each of chlorate of potash and tincture of muriate of iron in a pint of water. Repeat this every four hours. Bathe the affected parts with crystallized carbolic acid, using one part acid to eight parts water. All sick animals should have pure air, and must be protected from rain and hot sun, and provided with an abundance of good food. If the kidneys become affected, give one ounce doses of saltpetre in drinking water, and if bowels are inactive, give one half-ounce doses of linseed oil until relieved.

All animals dying from the disease should be at once ~~buried~~ burned on the spot and the place afterwards disinfected by sprinkling with carbolic acid or lime.

S. M. TRACY,
DIRECTOR.

MISSISSIPPI

Agricultural Experiment Station

BULLETIN NO. 7.

HAY PRESSES.

AGRICULTURAL COLLEGE, MISS.

JUNE 20TH, 1889.

HAY PRESSES.

In the making of hay for shipment, a good press is as important as any other item in the machinery used. This is especially true of the hay grower who ships by rail, as, up to a certain point, the net price which he will receive for his crop depends on the number of tons which can be packed in a car.

Recognizing this fact, and wishing to place the peculiar advantages and defects of different presses before the public, the Station invited the different manufacturers to meet at the Station on June 18th and 19th, for a competitive exhibit of their respective presses. This invitation was accepted by the following manufacturers: viz,

Progress Manufacturing Co., Meridian, Miss., "Ideal" Press.

Jacob Holberg & Son, Macon, Miss., "Hunter" Press.

Southern Standard Press Co., Meridian, Miss., "Hamilton" Press.

Kansas City Hay Press Co, Kansas City, Mo., "Lightning" Press.

The following descriptions were furnished by the respective manufacturers:

THE "IDEAL" HAY PRESS,

For baling hay, straw, moss, etc. Prices f. o. b. Cars at Factory: Mounted Press, Steel Lined, $185.00. Not mounted Press, Steel Lined, $150.00. Every Press is Steel Lined. Bales 14x19 inches, variable length.

The "IDEAL" Press is of the reverse travel, double acting, continuous type; that is, a charge of hay is fed in at each turn of the horse, and the bale is continuously being tied and discharged.

In baling with a press of this type, at the beginning of its travel the resistance

against the plunger is very slight and increased but little during the first half, but by the time two-thirds or three-fourths of the travel is reached the full power is required. To get the maximum power of horse or horses for as small an amount of travel as possible, the plunger should move very rapidly at first, leaving as much as possible of travel and consequent power to be used in the last few inches where the resistance is great. This cannot be accomplished with a press which uses only the bell crank principle of power. As with this principle the plunger moves slowly at first, faster at the center, then slowly again, but only about one-fourth of the entire amount is utilized upon the last eight inches travel where the resistance is great. Usually the leverage on these presses is as the length of the lever (say 16 feet) is to the length of crank (or other device in its stead) 16 inches; the only increase of power being due to the crank passing the center, and this increase comes too late in the travel to be of advantage except in packing very light charges which means very slow work.

The inventor of the "Ideal" Press has perfected a device as simple, durable and inexpensive as the bell crank, which gives exactly the movement desired. The plunger travels the first 20 inches very quickly, requiring the horse to move only one-sixth of a full circle, leaving the balance of the travel to be concentrated upon the last eight inches where the leverage is as the length of the lever (12 feet) is to six and one-half inches with a still further gradual increase until the end of travel is reached. This enables us to pack full charges with as much ease as light ones.

A press that requires two horses to pack bales of commercial density is a very expensive device to use, not only because it requires the use of two horses but because the working of two horses is slower than one on account of the much greater time required to turn around.

Our "Ideal" press is compact in its construction throughout, and while this compactness enables us to use a minimum amount of material, hence make a light press, it also enables us to make a much stronger press than is usually built. A careful study of construction has enabled us to make one piece answer in many places where others use two or more, and secure no more strength or durability, hence the "Ideal" is not only the most powerful horse power hay press made but the lightest.

This press has a very large feeding capacity, and having power to press large charges into very small bales, enables it to do vastly more work than any other press. This press uses no doors. It is provided with a retaining folder, which automatically folds down each charge as pressed, making smooth, compact bales and saving the necessity of care by feeder, to press hay down into the feed chamber. The plunger in this press returns instantaneously, when it has reached the end of its travel. The construction of this press is everywhere most simple, it has fewer working parts than any other and is entirely free of cogs, pulleys, ropes, belts, sheaves, triggers, or traps.

With this press, when hay is kept convenient, one man to feed hay into press, one to put on ties and a boy to drive one horse, can bale 150 to 200 bales per day—bales 14x19, 3 feet long, weight, 109 to 120 pounds average—according to quality and condition of the hay. With this press one horse can bale as much hay and load as much to the car (10 to 12 tons) as two horses can with other horse power presses. It is undeniably and certainly the most powerful and the quickest horse power baling press made, doing more work with less labor of both man and beast than any other press. The adjustment for pressure is quickly made or released. Wet charges or other obstructions cause less trouble than with other presses. In short, we confidently assert, and experience will prove to any user, that while our press is cheaper in first cost, it is also in all respects superior to any other.

It is mounted on four wrought iron wheels 30 inches in diameter. The wood work of this press is made of yellow pine, which experience has proved the best for such purposes. While lighter than any kind of oak, it has equal and much more uniform strength, and it will keep its shape much better. Our press is thoroughly bolted and stayed with bolts and rods. All wearing parts are iron and steel with large surfaces and bearings. While other presses depend only on the recoil of the hay to return the plunger, which cannot always be depended on, we use a spring which insures its proper return.

The recoil is taken up by a friction brake. The entire length of our baling chamber is lined with the best homogeneous steel, no wood anywhere coming in contact with hay after it is under pressure.

To set up and go to work, is only an operation of a few minutes. Weight not mounted, about 2,000 pounds; mounted, about 2,500 pounds. With the unmounted press is furnished platform, wrench and single tree for the lever. With mounted press we furnish anchor braces, platform, wrench, single tree for levers, single and double-tree and breast yoke for tongue

GUARANTEE. This press is guaranteed to pack 15 bales of hay, 3 feet average length 100 lbs. average weight, with one medium horse or mule per hour, and to be made of good workmanship and material.

THE CONDITIONS OF THIS GUARANTEE ARE: The purchaser who desires to claim guarantee, must, within 6 days from arrival of press at his receiving point, notify the manufacturers that he fails to make press come up to guarantee, giving a description of his method of operating same and stating wherein it fails.

Receiving this notice, the manufacturer may either forward further instructions by mail, or send a man to try the press. If a man is sent, the purchaser must afford him immediate and proper means of operating the press, and if the man sent fails to make

press fulfill guarantee, the manufacturers agree to return whatever they may have received for the press and refund all freight to purchaser and take press off his hands. If the man sent succeeds in making press fulfill guarantee, the purchaser must pay said man's full expense of going, staying and returning, but no charge will be made against purchaser for said man's time, unless prompt opportunity for testing has not been afforded him. The guarantee of material and workmanship means that should any part fail or break in the legitimate operation of press within one year from shipment, it will be furnished f. o. b., Meridian, free of charge.

Fifteen bales, 100 lbs. average, per hour, is not the usual maximum work of press. The amount that can be done, depending on operators and quality of hay to be pressed. With fine, easily pressed hay, active operators, 25 bales per hour can frequently be reached, and 30 bales per hour sometimes can be done. Also of some hay, 150 lb. bales 3 feet long can be made with ease.

HUNTER PRESS.

Manufactured by Jacob Holberg & Son, Macon, Miss.

Advantages claimed for the J. W. Hunter Hay Press:

1st.—Its simplicity and smoothness of action, having no rebound of plunger, causing no jerk or jar on team or press.

2d.—Its durability, having fewer and larger bearings.

3d.—Convenience of feeding, being able to tramp one charge in hopper on plunger while it is packing previous one, giving more time, less danger, etc., as plunger has a smooth and uniform motion.

4th.—In holding hay on smooth sides of bale instead of drawing down top not only requiring much less changing of tensions but also enabling us to have dividing blocks nearer height of feed chamber; causing ends of bales to be smoother.

5th.—Its cheapnsss, costing only $75 not, or $100 mounted.

LIGHTNING PRESS.

Manufactured by the Kansas City Hay Press Co., Kansas City, Mo.

We have a FULL CIRCLE SWEEP, which dispenses with the expensive assistance of a driver, a vast improvement over the old, cumbersome, awkward half-circle, which necessitates excessive time and fatigue to team in continually turning back; the full circle making two full strokes of plunger to each round of team.

The lightning Press is made almost entirely of STEEL, a fact which needs no comment to convince the most credulous of its superiority over the Wooden Press which is at all times susceptible to continuous breaks.

We have adopted a Tucker which laps or folds the hay down in front, making smooth solid bales. The iron Plunger is built with an adjustable top, which prevents it from ever wedging, and any hay that laps over the top is tucked down and helps make the bale compact and even.

We discovered that the power could be materially improved, and by continual experimenting, have adopted a very simple, effective power, which enables us to use a shorter crank and get a longer stroke, our Pitman now travels nearly straight in and out, not swinging out so far as formerly, thus giving the team more ease in crossing the Pitman. By the New Power Device used, the leverage and power steadily increases until, at the last few inches of plunger movement, the power is enormous—the power being so strong that bales of great weight can be made, and is arranged so there is no jerk whatever on the team passing the center, and no pull crossing the Pitman. Desiring further to improve the press, we have lengthened the Feed Hopper six (6) inches, which allows of much larger charges of feed, and as we have greater power than other presses the work is much more rapid. Thus, we have the simplest full circle, as well as the easiest Press on team and men, and the most rapid in in its operations. Our improvements have been thoroughly tested, and are giving perfect satisfaction wherever used.

The whole Press is constructed of the best material and in first-class, workmanlike manner.

The steel used in construction of Baling Chamber has a tensile strength of 60,000 lbs., and is the same as used in boilers. It is riveted to the steel angles with red hot rivets.

We have reduced weight of press considerably by using steel plate, where we formerly used cast iron, thereby increasing strength of parts and durability of Press, and reducing draft on team until we have the lightest Draft Press on the market.

The Tying Chamber is made of Steel Angles, so compactly arrangsd that there is nothing unnecessary or in the way about the Press. For tying purposes, any kind of wire or cord can be used.

The tying and threading can be done from the same side of Press, by one man or boy, without any walking around, as Tying Chamber is made of steel angles, and is only 24 inches high, thereby doing away with passing around Press or employing two men.

The Tension is at extreme end of Press overcoming the friction of the ordinary Press, thereby reducing draft on the team to the minimum, and at the same time giving com-

plete control over the Tension to such an extent that we can make the bale of any desired weight.

The Axles used in Mounted Presses are made of steel. The hind Axle is in crank shape, and is so fastened to Press that it can be lowered to the ground in a second, and raised by a draft team, which is much easier and quicker than by the use of jack as formerly.

The main Bearings and Pins are of steel, insuring durability and strength. Our Spring Top Plunger enables us to feed hay without doors and the risk of getting the Plunger caught. Owing to the Press being made of steel, the baling of damp hay is accomplished with the same ease as with dry hay; with wooden presses this would be impossible. What little wood we use in building presses any farmer could easily replace, if it should in time rot out.

We have, during the past winter, strengthened our machine in every way. We make the crank with one-third more wearing surface and in every other point where our machine has shown a weakness by severe usage we have strengthened it, thus insuring double strength in all parts.

In baling wool, cotton, hair or other material to be packed into burlaps, the sack can easily be slipped over Angle Irons, and receive bale, and all there remains to be done is to sew up sack.

HAMILTON PRESS.

Manufactured by Southern Standard Press Co., Meridian, Miss.

(The manufacturers of this press promised to send a full description, but none has yet been received, and it was thought best to delay the publication of the report no longer.—S. M. T.)

Before beginning the contest, the following rules were agreed upon for the guidance of the work.

Each press must bale at least one thousand pounds of hay per hour, but before time is called for any press to begin work the exhibitor will be allowed to use as much time and to make as many bales as he may desire, to get his press in good working order.

The average weight of bales in any contest must be not less than fifteen pounds per cubic foot, and no additional credit will be given for a weight exceeding twenty-five pounds per cubic foot.

In grading density of bale, any press making a bale which weighs twenty five pounds per cubic foot will receive a credit of the maximum grade, 30 points, and a press making a bale weighing fifteen pounds per cubic foot will receive a credit of one point. If the weight per cubic foot is between these two figures a proportional credit will be given. Credits for other points of contest will be judged in a similar manner.

Any press failing to make a speed of at least one thousand pounds per hour, and a density of at least fifteen pounds per cubic foot will receive no credits on these points.

One thousand pounds of hay will be furnished to each press for each trial, but any press which may desire it shall be allowed a second trial on the same conditions as

the first trial, and will receive a final credit consisti
of the average results of the two trials.

Weight per cubic foot will be ascertained by measuri
and weighing bales after they are taken from the press.

In making the test for portability the Director may,
any time during the trial, give an order for a mov
When this order is given to any press the press will sto
work at once, pull up, hitch on a team, and reset at suc
point as may be directed, and begin work again. Tim
will be counted against each press from the time the ord
to stop work is given until the press is ready for work a
ter resetting. In order to show that it is ready for wor
each press must complete a bale in its new position b
fore time will be counted.

A second test for portability may be made in a simil
manner, except that the press may be directed to make
haul over rough or plowed ground.

In making the tests for portability, after the order f
moving is given no change can be made in the tension
any press.

Each press will be allowed to make separate trials wit
one and with two horses, and separate records will
made of each trial.

Presses will be graded on a scale of 85 points, divide
as follows:

Weight per cubic foot of bale	30
Speed	25
Horsepower	15
Appearance of finished bale	5
General opinion of the judges	10
	85

In the "Opinion of the Judges" was included the ge
eral work of the press and many other points which e
ter into its value, which were not covered by the oth
points in grading, but did not include a consideration
either price or durability.

Prof. J. H. Connell, Professor of Agriculture and Supe
intendent of the Agricultural College Farm, Mr. J.
Rand, an extensive hay grower of Oktibbeha County
and S. M. Tracy, Director of the Agricultural Experimen
Station, were appointed to act as judges, and W. L. McGe

sistant Director of the Experiment Station, was select-
o weigh and measure the bales. The weighing was
e on a Fairbanks scales and the measuring done by a
per rule with arms nine inches in length and placed
ight angles to the body of the rule. Each bale was
asured in two places in each direction, and the aver-
of the two measurements made the record.

he density of each bale was ascertained separately by
iding the weight by the number of cubic feet, and the
de for density was reached by giving a credit of three
nts for each pound above fifteen per cubic foot of bale.

he grade for speed was made by using the best speed
le (1000 pounds in 18 minutes) as a standard, and one
r as the extreme limit of time.

this way, the grades for density and speed are sim-
matters of record, while the "horse power," "appear-
e," and "opinion" are matters of judgment.

uring the contest, each press was required to pull up,
ke a short move, and reset, as a test of portability, but
here was practically no difference in the time requir-
or this by the Mississippi presses, by mutual consent,
rading was made on portability. The Mississippi
ses were all mounted on wheels of very nearly the
e diameter, and could be moved over any ordinary
nd with a single team. The Lightning Press is
h longer than any of the others, being nineteen feet
een axles and only ten inches from the ground, so
it is difficult to turn in a narrow place, and the
ht of the press is too great to permit it to be hauled
plowed ground without the use of four mules.

he hay used in the work with one mule was clover
a small mixture of grass, which had been in the barn
t a month, and was sufficiently damp to pack easily,
the hay used for the two mule contest was a rather
quality of Johnson grass which had been in the barn
bout nine months.

the close of the contest, each press was weighed, and

the selling price of each given by the manufacturer, as follows:

Press.	Weight. lbs.	Price.
Ideal	2620	$185.00
Hunter	2625	100.00
Hamilton	2544	185.00
Lightning	3275	310.00

After setting and making as many preliminary bales as were necessary to see that the presses were in good running order, the "Ideal" was the first to announce itself as being ready for the test. One thousand pounds of clover hay was weighed out to it, and time counted from the time the order for starting was given until the block was pressed back against the last of the hay.

In the opinion of the judges, the work done by this press was easier on the mule than was that of any other press, as the pull in no case caused the mule to stop walking, and the rebound of the traverser was taken in such a way that the lever and singletree did not strike the leg of the mule, as they did with most of the others. The bales made were excellent in appearance, being quite smooth on the sides, and usually so on the ends. The density of the tops and bottoms was very nearly even and the bales more nearly regular in form than were those from either of the other presses. In none of its three contesting runs was the "Ideal" obliged to stop the mules for any cause, excepting once to adjust the harness which had become loosened.

The other two runs made by this press will be mentioned in their proper order.

The "Lightning" was the second press to be ready for work, and was furnished the same amount of hay of the same quality as that given the "Ideal." Its work was completed in a shorter time than was required by any other press, and the bales made were more dense than those made in the previous trial. Only eighteen minutes were required for the work, but it was so hard that no mule could have endured it for any great length of time. Very frequently the heavy mule used was obliged to make several efforts before it could force the traverser back, and the rebound threw the lever and singletree against its leg

with considerable violence. In the opinion of the judges, this press cannot be worked profitably with one mule, and ought not to have been permitted to enter this part of the contest. In the setting of this press, the body is let down so as to rest on the ground, which saves a little labor in pitching the hay, but is inconvenient for tying, and makes it necessary to remove each bale as soon as it is free from the press. The traverser failed to rebound properly and had often to be pushed back by hand, a defect which was afterwards remedied by setting the press in a different position.

In the table giving the final results, the two grades of 0 given to this press refer to its value for use with one mule only, and not to its fitness for work with two.

The "Hamilton" pressed the same amount and quality of hay as did the others. The power required, though not more than two mules could furnish by changing, was decidedly more than was needed with the first press used, and a much longer time was required for the completion of the work. The bales made were very heavy, weighing over twenty pounds to the cubic foot, and quite smooth, but were somewhat curved on account of their being more dense near the bottom than at the top, a defect which would make the bales pack loosely in a car and render them more liable to break open in handling.

The managers of the "Ideal," believing they had worked at some disadvantage in being placed first on the list of contestants, claimed a second trial, in which they made quicker time and a denser bale than did any other press with the use of one mule. When speed and density were both increased, of course more power was required. Although this test was run through with a moderate sized mule which did not seem overstrained, the judges were of the opinion that such a rate of work could hardly have been continued through the day, even by using two mules interchangeably.

The managers of the "Hunter" press were unfortunately delayed by a railroad accident and didn't arrive in time for this part of the contest.

TWO-MULE TESTS.

In making trials of presses with two mules, the stiff Johnson grass which was used materially lessened the density of the bales. The clover used previously was so damp that it was comparatively easy to make a heavy bale, while the Johnson grass was selected for the last trial because it is the most difficult to bale of any of our Southern grasses.

The "Hamilton" was the first press called to work, but owing to a mistake in the making of the traverser sent with the press, was obliged to stop when only two bales had been completed.

The "Ideal" changed its lever, using one 12 feet 3 inches long in the place of one 15 feet long which had been used in the previous trials. Its speed was about the same as in the previous trials, and the bales much lighter, though more dense than those made by any other press. In appearance they were as good as could be expected from the quality of the hay, but were not as smooth as those made from clover.

The "Hunter" was called next and completed its work in thirty-nine minutes, with an average density of 18.23 pounds per cubic foot of bale. The work seemed hard for the mules, which had occasionally to make a second attempt before the traverser could be forced back, and several of the bales were uneven in appearance. In this press, the traverser is drawn back from the charge by the team, so there could be no trouble from the rebound. The press is much lower in price than any of those present, and the character of its work was all that is necessary for the farmer who has only a moderate amount of hay to bale.

The "Lightning" was the last to be called and completed its work in less time than did either of the others, using only nineteen minutes and securing a density of 15.47 pounds per cubic foot. The bales were good, but not quite so smooth as those from one of the other presses. The team did not seem overworked, and the rebound acted fully.

The representative of this press made a protest against

the division of points in grading, claiming that the horse-power required should not be charged with more than ten points, and that at least five points more should have been given to speed.

Full details and the grading of each trial are given in the following table:

Number of test in order, as run.	Name of press	Mules used.	Kind and amount of hay pressed.	Time consumed, in minutes.	Weight per cubic foot of bales. (Density.)	Grading, as per scale of points adopted.				
						Speed.	Density.	Strain on team.	Appearance of bale.	Opinion of judges.	Total.
First	Ideal	1	1000 lbs clover	23.0	18.86	22.00	11.58	15 00	5.00	10 00	63.58
Fourth	Ideal	1	1000 lbs clover	19.0	21.97	24 40	20.91	12 50	5.00	10 00	72.81
	Average			21.0	20.41	23.20	16.24	13.75	5 00	10.00	68.19
Second	Lightning	1	1000 lbs clover	18.0	19.72	25 00	14.16	.....	4.50	....	43.66
Third	Hamilton	1	1000 lbs clover	44.0	20.36	9 57	16.08	12.50	2.50	5.00	45.65
Fifth	Ideal	2	1000 lbs Johnson grass	22.5	18.76	22.08	11.28	15.00	5.00	10.00	63 36
Sixth	Lightning	2	1000 lbs Johnson grass	19.0	15 46	24.40	1.38	14.00	4.50	10 00	54 28
Seventh	Hunter	2	1000 lbs Johnson grass	39.0	18.23	12.50	9.69	10.00	3 50	7 00	42 69

It was urged by several that in grading the presses attention should be given to price and durability, but as the list prices of each are given there seemed no necessity for grading on such a point, and the judges did not think that any reliable estimate of comparative durability could be made from seeing a press work for a few hours only, so neither of these were considered.

A car eight feet wide, seven feet high, and thirty three feet in length contains 1848 cubic feet. Twelve tons of hay, baled with a density of 15.47 pounds per foot, will occupy 1551 cubic feet, leaving 297 cubic feet, or 16 per cent. of the available space unoccupied. If baled with the greatest density secured during the contest, 21.97

pounds per cubic foot, it would occupy only 1092 cubic feet, leaving 756 cubic feet, or nearly 41 per cent. of the space unoccupied. The space occupied in the car is of vital importance to the shipper as freight costs no more on a car holding twelve tons than on a car holding only nine or ten tons, and the amount of freight paid is just so much out of the price received by the shipper. No shipper can afford to buy at any price, or even to use a press which will not give a density of at least fifteen pounds per foot. For the hay grower who expects to sell his crop in a local market, or who bales for convenience in storing, such density is of less importance, while speed and cost should be more carefully considered.

S. M. TRACY,

DIRECTOR.

MISSISSIPPI

Agricultural Experiment Station

BULLETIN NO. 8.

STOCK FEEDING.

AGRICULTURAL COLLEGE, MISS.

AUGUST 30TH, 1889

SILOS.

How to feed stock in the cheapest manner, is the most important question with the stock grower today. The silo system has practically solved this problem.

Ensilage or silage, both words meaning the same, aids digestion and increases the appetite of the cattle in winter; for everything else is dry and heating and the stomach requires something of the kind. So in addition to what we may call a very cheap food we have a very healthy and appetizing feed.

STYLES OF SILOS USED AT THE STATION.

We had two styles of silos the past season. One, the most primitive imaginable. It was made by simply piling up the silage in as round and compact heap as possible and covering with dirt about twelve inches thick, dug from all around the base of the pile, the excavation acting as a drain.

This cheap silo was built of chicken corn. It was cut October 10th, just as the seeds were turning black or brown. The stalks were put in whole and piled straight. The heap was then dressed off and smoothed up by setting the stalks on end and around it. About eight tons were put into the heap and the whole covered with earth. Then a thin layer of stalks was spread over the earth to shed water. It was opened January 19th. As might be expected, for three or four inches down, it was discolored, but all below that was green and sweet. Cattle ate it readily and there was no trouble in getting them to eat that which was discolored. When the heap was opened, ten or twelve head of cattle that had never seen ensilage before happened to be near by and they ate it greedily.

The chicken corn was cut with corn knives and carried to the heap. Putting on the covering of dirt was very little expense.

as it could be thrown rapidly with a fork from the surrounding ground on to the pile. Seventy-five cents per ton covered all expense of cutting, hauling, covering, etc.

Care was taken to have no openings into the heap and no cavities in the pile, as the air should not come in contact with the silage. As the pile settled, the dirt adjusted itself.

PEA VINE ENSILAGE.

Some Pea vines were packed in a wooden silo twelve feet by twelve feet by sixteen feet. This silo was filled in September and additional silage was added from time to time as the vines sunk down. Planks, cut to fit in the silo so they would sink with the vines, were laid across the top.

In some parts of the silo, the vines were nicely kept, having been cured as hay, but in other parts it was quite black and even rotten. The cattle ate the nicer parts readily but refused the blackened portions or ate it very sparingly.

This failure in the preservation of the ensilage was doubtless owing to the impossibility of packing it sufficiently close without cutting.

DESCRIPTION OF THE SILOS.

We have three silos built in one end of the barn, with capacity of seventy-five tons each. A Belle City feed cutter is near the center of the barn and the ensilage is carried up into the silos on a carrier.

The foundation of the silos, which is three feet deep, is of brick and cement. On this the wooden structure is built. The sills and plates are six inches by ten inches, made by nailing together three timbers each two inches by ten inches. This plan saves mortising. The girts are made in the same manner. Of course, the barn posts serve as posts for the silo. The planks, one inch by twelve inches are nailed on uprights and tarred paper is placed between. The walls are made of two thicknesses of plank. At the door, which is three feet wide and as high as the silo, the inner layer of plank lacks six inches of reaching the edge of the outer layer, as they are put on "breaking joints." The section doors are made just to fit the opening, three feet wide and four feet high, and are put in place from the inside.

BILL OF MATERIALS NECESSARY FOR CONSTRUCTING THE THREE STATION SILOS

Material.	Inches.	Feet.	Total Feet.
12 plates.	2x10	16	320
18 plates.	2x10	14	420
12 sills.	2x10	16	320
18 sills.	2x10	14	420
24 girths.	2x10	16	640
12 inner girths.	2x10	16	320
48 girths.	2x10	22	1760
48 corner ties.	2x12	2	160
350 wall plank.	1x12	20	7000
12 corner pieces, perpendicular sides, 6 in. x 6 in., and diagonal face 8 in., 20 ft. long.			360
42 plank for top, 1 in.x12 in. 15 ft.			630
45 " " " 1 in.x12 in. 14 ft.			630

Brick for walls and floor.	7000.
Cement,	6 bbls.
Nails, 10d.	100 lbs.
Spikes, 20d.	50 lbs.

The corner piece consists of timber sawed with a cross section of triangular shape, the perpendicular edges being 6 inches wide. These are put in the corners to fill the angles where moulding is most likely to occur.

The wooden silos, built above ground, will preserve the ensilage quite as well as those built below ground, and are cheaper to construct. In filling the silo, machinery is used, so lifting it up by this means is very little expense when compared with throwing the silage out of a stone silo constructed below ground. In one case the ensilage is lifted up by machinery and thrown down by hand, and in the other case, it would be thrown or allowed to fall into the silo and lifted by hand when fed out. It is true it could be lifted out of the silo by steam or horse power but that would be expensive, to run machinery every day to hoist a few hundred weight of ensilage. Too much stress cannot be laid on this point. It is easy to get it up into the silo by steam and then it is very easy to load the feed carts. The difference in

throwing the ensilage out of the silo and throwing it down was very noticeable in our silos; when we got below the level of the floor, it took much more labor to load the carts than when the ensilage was high in the silo. It takes very little steam power to run successfully a carrier kept in good order.

The height is an important item for two reasons: First. The greater the height the greater the pressure. It will keep better when subjected to pressure as there is less chance of air cavities in the ensilage, and less surface will be presented at the top where it is most liable to spoil. Second. It is advisable to feed from the top, taking off the whole surface every day. By this method, all of the ensilage that is exposed one day will be fed to the cattle the next. By using section-doors, this method of emptying the silo is made easy. This style is far superior to cutting feed in sections from the sides. The smaller the area of the upper surface, the deeper the layer taken off daily, hence, there is less chance of spoiling from exposure to air. Of course there is the disadvantage of having to hoist the ensilage very high but the pressure will be greater.

We put the ensilage in rapidly and tramp it around the edges. Planks are cut just to fit in the silo and put on two layers, one across the other. These sink with the ensilage and thus the air will be excluded. The planks are covered with waste hay.

The Station silos were filled with corn, sorghum, pea vines, chicken corn, and a little teosinte.

The sorghum yielded at the rate of 37,860 pounds per acre, corn 30,208 pounds, and teosinte 26,320 pounds.

CHEMICAL ANALYSIS.

	Water	Crude fibre	Crude Protein	Ether extract	N. Free extract	Ash
Corn	85.31	1.67	1.19	.47	9.05	.31
Sorghum	85.84	3.20	1.04	.28	8.35	1.29
Teosinte	66.77	12.35	2.54	.70	15.87	2.97
Chicken Corn	75.02	8.98	2.45	.81	11.60	1.89

The different crops were put into the silo within six hours after they were cut.

The sorghum ensilage was brown eighteen of twenty inches

near the top. The corn was brown for about six inches though not spoiled that far down as the cattle would eat it, but it was not first-class ensilage. The first silo was opened on November 17th, the second on January 20th, and the third on March 1st.—The temperature of the third silo was taken when the centre was reached and found to be 74 F. The ensilage in this was quite as green or greener than in the first two. It looked as though it had been cut and allowed to wait in the shade for a day or two and had very little of the alcoholic odor. This silo was filled a little more rapidly than the other two as the labor was more skilled and we could get along faster, and the silage was not quite so well matured, as it was planted later. The ensilage in this silo was better than that in the other two as it had a finer color and scarcely any of it was in a damaged condition.

Corn has given better satisfaction with us than has any other plant used. Sorghum gave the largest yield, but the cattle ate the corn more readily and it seemed to keep better.

Our heavy clay soils are broken early in the spring with a two-horse plow, plowed in lands eight feet wide, and planting is done about the middle of April. As it is desirable to plant on fresh plowed land, a three-mule spring-tooth harrow is run over the land just before the corn is planted. Two rows are planted to each land. Thus the rows are four feet apart and two or three stalks are left in hills about ten inches apart, the exact distance being determined by the fertility of the soil. Just after it comes up it is run over by with a Thomas's smoothing harrow.

It is cultivated the first time with a five-toothed cultivator and the second time with a double shovel. Then it is thinned to one stalk in a hill, as there is no further danger of covering it with the plow. We plant about twice as thick as will be needed, as it is better to waste a few seed than have an irregular stand, and cultivate thoroughly till the corn is about five feet high. We manure heavily with barn-yard manure as the corn is an exhaustive crop and requires a great deal of organic matter.

Experiments were made last season with corn sown broadcast and drilled.

Plot No. 1 drilled yielded 23,425 pounds per acre

Plot No. 2 broadcast yielded 20,500 pounds per acre.

When sown broadcast, the mowing machine was used in harvesting the crop, but when drilled, it was more convenient to use the regular corn knife and lay the corn in piles across the rows.

It is a great saving of time to plant ensilage as near the barn as possible. The expense of hauling will not be so great and the large amount of manure required can be applied with less cost.

Our cutter was set to cut it in half-inch lengths, as when cut short, it will keep better and is eaten cleaner by the cattle.

CHICKEN CORN VS. CORN

Chicken corn (*Sorghum vulgare*) grows so luxuriantly over a large portion of the State, that it is a great pest in many of our cultivated fields and has to be cut down four or five times each year. On bottom land it will come up and make a good crop after being cut near the ground in August. It is very difficult to subdue and almost impossible to kill. We have a few seed gathered last fall and this spring when we were doing our heaviest plowing, two mules were fed on corn and mixed hay and two on chicken corn and mixed hay.

In order that the two pairs might be put to equal work, we put one of each pair on chicken corn seed and one of each pair on corn. These mules were used in breaking ground with a double horse plow. Heavy work was selected to give all a severe trial. No's. 1 and 2 and No's. 3 and 4 were matched. No's. 1 and 4 were fed on corn and No's. 2 and 3 on seed of chicken corn.

AMOUNT OF FOOD AND WEIGHT OF MULES.

	Corn in Pounds	Chicken Corn	Mixed Hay	Weight at beginning	Weight at close	Loss
		lbs	lbs	lbs	lbs	lbs
No 1	189		189	1005	1029	42
" 2		178½	189	895	882	16
No 3		204	252	991	882	32
" 4	252		252	911	910	4

The difference in loss between the two pairs was two pounds in favor of the corn, showing that the feeding value of the chicken corn is about as high as that of the corn.

It should be taken into account that the chicken corn was a new feed to the mules and of course they had to become accustomed to it.

COMPOSITION OF FEEDS.

	Water	Crude Protein	Crude Fiber	Fats	Ash	Carbo-hydrates
Chicken Corn Seed	11.87	10.12	8.70	4.00	1.80	70.00
Corn Meal	15.20	7.87	17.45	5.20	2.00	52.07
Mixed Hay	11.84	6.00	33.75	1.80	6.88	39.73

This is the chemical analysis made of these feed stuffs at the Station Laboratory. Corn is worth fifty cents per bushel and chicken corn costs only its gathering. Instead of cutting it out of our fields four or five times per year, we may find that it is to our interest to cultivate it as a seed crop.

The amount of dry matter per acre to be produced in the seed cannot be definitely known until further tests are made; but for hay and meadow uses, this is one of our most productive plants, and in many localities is regarded as one of our most valuable hay plants.

CALF FEEDS

On the 2nd day of February, twenty-one calves were put up in seven lots of three each. No. 1 in each lot was a grade Holstein and No's. 2 and 3 were grade Jerseys. We wished to find the values of the different feed-stuffs and to compare the Holstein grades with the Jersey grades. The feed was carefully weighed to them twice a day and what they left was re-weighed, so they were only charged up with what was actually eaten. They were given one week of preliminary feeding and the test continued eight weeks following.

The tables give weight of feed and gain of the seven lots for the eight weeks' test in a condensed form. Instead of giving the daily feed given to each calf, we give simply the total feed actually consumed. Each calf was weighed every seventh day, six hours after the morning feed.

The weather was cold and stormy most of the time these experiments were in progress.

FOOD and GROWTH.

Lot	Time	Original Weight	Final Weight	Gain	Per cent of Gain	Food			Cost of food per pound
						Amount	Protein	Cost	
A	Feb. 9—April 5	104 lbs	[illegible]	206 lbs	51.7	Skimmed milk—Cotton seed meal 2405	271.3	Milk $11.04 Meal $7.76	[illegible] cents
B	Feb. 9—April [illegible]	[illegible] lbs	305 lbs	19 lbs	33	Whole Milk 2241		$7.39	[illegible] cents
C	Feb. 9—April [illegible]	[illegible] lbs	741 lbs	125 lbs	25.7	Skimmed Milk—Wheat Bran 2179	476	Milk $10.[illegible] Bran $4.46	12.7 cents
D	Feb. 9—Mar. 9	360 lbs	423 lbs	73 lbs	9.46	Digestible Food 891		$3.09	4.65 cents
E	Mar. 9—April [illegible]	[illegible] lbs	467 lbs	67 lbs	10.9	Corn Chops 825		$2.31	3.8 cents
F	Feb. 9—April 5	313 lbs	778 lbs	365 lbs	51.2	Skimmed Milk 4286		$15.19	7.46 cents
G	Feb. 9—April 5	556 lbs	701 lbs	145 lbs	25.6	Cracked Cotton Seed 732		$4.06	7.1 cents
H	Feb. 9—April 5	545 lbs	758 lbs	213 lbs	17.5	Cooked Cotton Seed 879		$3.69	4.25 cents

[TABLE B.]

COMPOSITION OF FOODS.

	Water	Fat	Protein.	Crude Fibre	Ash	Carbohydrates	Casein.	Sugar
Skimmed Milk	90.6	0.9			0.9		4.5	3.6
Cotton Seed Meal	8.49	8.64	40.68	8.07	7.89	26.41		
Whole Milk	87.13	4.11			0.81		3.43	4.49
Wheat Bran	13.52	3.41	16.56	8.23	4.57	51.61		
Blatchford's Food	10.11	6.22	26.01	6.63	6.13	54.91		
Corn Chops	15.94	2.95	8.56	3.06	1.75	62.26		
Crushed Cotton Seed	13.00	29.49	22.68	28.11	5.92	27.90		
Cooked Cotton Seed	54.08	9.41	10.41	10.63	2.67	12.82		

RESULTS

No. 1. The grade Jerseys increased in weight faster than did the grade Holsteins.

No. 2. The Blatchford's food did not give good results when fed alone, but when mixed with other food proved satisfactory. Our experience shows it can be recommended highly for use in connection with other feeds.

No. 3. The experiment shows that whole milk was fed at a loss.

No. 4. From these experiments we draw the conclusion that cotton seed in some form is the cheapest of the feeds.

[Note.—Prof. Irby resigned his connection with the Station on June 30th, but as the work for the preparation of this Bulletin was done under his supervision, it is published in his name.]

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION.

BULLETIN, NO. 9.

DISEASES OF SHEEP AND CALVES.

BITTER WEED.

D. L. PHARES, Veterinarian

AGRICULTURAL COLLEGE, MISS.

AUGUST 30, 1889.

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The Bulletins of the Station are sent free of charge to all persons in this State who apply for them.

SOME ENTOZOIC DISEASES

OF

SHEEP AND CALVES.

The following extract from a letter dated August 29, 1888, will give an idea of one of these diseases:

"The first symptom of the disease is a swelling under the lower jaw, which, when cut, resembles a colorless jelly. During the night the swelling almost, if not entirely subsides, appearing again about noon the next day. After about the fourth day the swelling under the jaw disappears entirely, and the upper lip becomes swollen, the countenance pale, and a very perceptible enlargement of the stomach. The victim lags behind the flock and shows little disposition to feed or ruminate. Every case so far has proved fatal The disease runs its course in from ten to fifteen days. After death, an internal examination reveals that the lungs are very much affected, unusually pallid, and sometimes symptoms of mortification. Around the large part or opening in the heart there clings that colorless jelly-looking substance. The liver in some instances is affected, showing spots on the surface, in others seemingly healthy. The abdomen outside of the bowels is filled to excess with reddish colored water. In fact, there is no natural blood in the sheep; but a pale, reddish-looking water seems to have taken the place of blood in all the veins."

OTHER ITEMS.

A personal friend wrote me at the same time;

"I saw one opened just after death this morning and the thing that impressed my unpracticed eye most was the absence of *any real blood*, being about a teaspoonful of clot blood in the heart, and nothing but bloody water anywhere else; also the clear, colorless jelly-like substance all around the base of the heart and thinly distributed over the intestines. One lung was colorless, the other *slightly purple*. The liver seemed perfectly sound. There are about 275 head of Merinos, which were brought here in January last from a point north of this in Texas. The sheep have grazed on a low, flat prairie on Galveston Bay, eating chiefly Texas sedge. In winter they were fed cotton seed meal,

and are in good living order. Mr. —— has also a small flock of Cotswold sheep, running on the same range, that are not at all diseased. The Merinoes also have scab, for which he dipped them in Buchan's carbolic sheep wash."

ANOTHER FLOCK.

In a flock of about 4000 Merinoes from the West, arriving in South Alabama in good condition in December, a letter received in May, 1888, reports a similar outbreak. An abstract follows:

"In January and February the loss wss trifling, but lost some during the long rains in March. I fed well with corn and cotton seed. The sheep did not seem usually well during the long rains in March. Many got lame, the skin peeled off their legs, looked as if they had been scalded. [In April the weather was all that could be desired, yet a new trouble came.] They run at the nose a little, soon afterward a small bunch appears directly under the lower jaw. It grows larger and larger, swells around the eyes sometimes. The upper lip will be very thick, and when bad there seems to be some difficulty about their breathing. Sometimes the sheep will last two weeks, depending on the strength of the animal. When the swelling is cut open it looks like thick jelly. They don't always run at the nose before it comes, but usually. Sometimes in the night the swelling will nearly all go down. There are others that seem drooping without any bunch or any apparent trouble. Their skin is very white, wool of a dull color, and neither looks natural. I have examined many. The liver, lungs and heart are not right. The heart seems swollen and liver of variegated color. Inside of the paunch or stomach is a small web-like looking material, very thin, which I never see in a healthy sheep. [Is this the jelly-like substance "thinly distributed over the intestines," mentioned in the letter from Texas?] The sheep don't seem to like the grass, occasionally gnaw bark or dirt, not as greedy for salt as usual, and drink very little water. This has been since the new grass. The throat trouble has been far worse since April and good weather."

GREAT MORTALITY.

Information from another source causes me to believe that in a few months about three-fourths of this large flock died. The writer adds:

Native sheep about here have the same trouble, but not till fall. Very few die some years, and other years more. There must be something lacking in the grass or water.

VEGETATION AND WATER AT FAULT.

No doubt both the vegetation and water are the sources of these fearful epizootics, as will be shown later.

BUNCH UNDER JAW EXPLAINED.

There is nothing mysterious about the "bunch" under the jaw forming during the day and disappearing during the night. The blood becoming disorganized, incoagulable and watery, the liver and lungs obstructed, and all the tissues weakened, more force is required to return the fluid from the pendent parts to the heart, while the vessels and muscles concerned in the circulation are less able to do the work. During the day, when the animal is grazing, the head being down, blood has to be raised much higher; while the mechanical obstruction is much increased, the liquid escapes from the vessels into those parts offering least resistance—the loose connective tissue under the jaw. When the animal lies down at night with the head on a level with the body, the mechanical obstruction is removed and the liquid returns from the swelling to the circulation, and in the morning the "bunch" has disappeared. So also of the swelling about the face, around the eyes and the lips. This swelling is inside as well as out, and hence the difficulty of breathing in many cases.

SEEN IN SOUND ANIMALS.

Every experienced stockman is familiar with the fact that when a grazing animal has been kept stabled many weeks, as during winters, and in the spring turned upon short grass for some hours, the whole head becomes swollen. But during the night the head being on a level with the body, in the morning has resumed its normal size. Other forms of illustration could be readily given.

WHY DO NOT THE COTSWOLDS ON THE SAME RANGE WITH THE MERINOES IN TEXAS SUFFER?

This may be accounted for in several ways, of which but two will be mentioned here. But either of these is sufficient answer to the question. First, Some families of the human race are extremely susceptible to tuberculosis, while other families cannot be made to contract pulmonary consumption, owing to difference of constitution; the latter never affording a nisus capable of developing the tubercle germ. So with these two breeds of sheep. The matter may perhaps be made more striking by restricting the numbers in the comparison. Here is a man who cannot live east of a certain mountain on account of his violent attacks of asthma, while his wife enjoys the most vigorous and uninterrupted health. West of the mountain his health is all that could be desired, while the wife cannot live there because of her violent attacks of asthma. The malady is developed in the one constitution under a combination of certain conditions, and in the other under a different combination. Many other illustrations could be given. The reader can make the application.

2d. While the Merinoes grazed on the low, flat prairie, "eating chiefly Texas sedge," the Cotswolds probably preferred other veg-

etation and drank from pools not visited by the Merinoes; the two flocks thus introduced into their systems different species of parasites, which will become more apparent later in this paper.

In Alabama, and in proximity to each other,

WHY WAS THE MORTALITY SO MUCH LESS AND LATER AMONG THE NATIVE SHEEP THAN AMONG MERINOES, BOTH HAVING THE SAME DISEASE?

It is not probable that the disease was identical in the two breeds. It is not probable that the two took into their bodies the same parasite or parasites, or in the same proportions. It is on just such "low, flat praries" as mentioned, and in and around stagnant pools in such localities, that sheep take in the eggs or larvæ of the worms that cause most of their fatal maladies. In and about a single pool often many species of sheep and cattle entozoa are found; and sometimes many species of worms are found in different parts of a single sheep, and again several species in the same organ. There are

SEVERAL SPECIES, ANY ONE OF WHICH CAUSES DEATH.

If two or more of these be present in an animal, it is more violently affected, with more complicated symptoms, and a speedier death. Thus we find often a fatal epizootic bronchitis caused in lambs by the lung thread worm which infests the windpipe, bronchial tubes and lung tissue. Another worm, infesting these organs, causes death by suffocation—their number and the tough mucus they cause to be secreted closing the air passages. Another causes death by reflex nervous irritation; another by anamia or destruction of the blood as described in the Texas letter above quoted. There are several other species of worms attacking other organs that cause anæmia, dropsy, white skin, pale skin, paper skin, pelt rot, hoose, etc., besides the fluke which causes "liver rot." All these parasites are picked up in such places as described above; none on undulating or hill land or salt marshes, if the sheep are debarred from stagnant pools, overflow bottoms, and are supplied with good well water.

WHY IS THIS?

Because all the above-mentioned parasites, and a number of others, are bred only in such places as described, or in places permanently moist. A single stagnant pool having drainage into it and surrounded by vegetation can, in a single day, supply every one of a flock of sheep with hundreds or even thousands of eggs or recently hatched lung thread-worms, too small to be seen except under the microscope. And the same may be said of other species of worms. Cobbold removed a mass of eggs from a single Strongylus micrurus, estimated to number 10,000; some of he m containing moving embryos. These eggs were 1-300 of an

inch long and 1-750 in breadth. The embryos escaped from the egg were 1-90 of an inch long and less than 1-1000 of an inch thick. This is the worm which is so destructive to calves, causing the swelling under the jaw, anæmia and dropsy. Many species of parasitic worms pass their several stages of development in different hosts. The eggs of the fluke, for example, being dropped in water, or washed into a pool by rain, hatch, the young being furnished with fine, soft, hair like appendages, swim about and are taken up by snails or other mollusks, or hatching on moist ground or plants, are thus taken in. The snails, crawling over plants, are swallowed by sheep and other ruminants grazing about the pools. So, also, large numbers of eggs and embryos of the lung thread-worms have been found in the common earth-worms, and in the pellets of earth which it deposits so abundantly on the surface of the earth and on plants, whence they are transferred to the ruminant. The microscopic, but active, speck may attain a length of three inches in the sheep's lung. This requires time. The embryos swallowed by the lamb in the spring develop sufficiently by August or September to cause the lamb to begin to languish, and in a few weeks die.

Sheep (native) over two years old rarely suffer seriously from these worms, while, if the spring be wet, it often occurs that nearly all the lambs die in August and later. Very early lambs die in spring or summer.

TREATMENT.

After the disease becomes developed, very little can be done with hope of saving the sick animal. If but few worms develop the case is not necessarily fatal. Often nothing of disease is suspected 'till anæmia occurs, when remedies are inefficient. Hence it will be perceived that

PREVENTION

is the rational treatment. The calves and flocks must be carefully and vigorously excluded from places where the first stages of the parasites occur. This paper is prepared not to teach flock-masters how to cure the disease, but the importance and means of prevention. On well-drained lands sheep and calves do not suffer from worm troubles, if kept in good condition, with pure water, plenty of good food and salt. Nothing is more fatal to these parasites and their first hosts—the snails, etc—than *salt*.

SALTING THE LAND.

If there be but a small area of moist land or stagnant water, a free use may be made of salt, the application being renewed after heavy rains. If the area be extensive the salting process would be too expensive to be adopted. The only safety, however, is dry, well drained pastures, supplemented with good water, and

sufficient wholesome feed to keep the animal in good condition. But it must be borne in mind that a flock already infested may perpetuate the parasites for a few years on the best situated pasture. Eggs and embryos are often expelled with mucus by coughing, and, falling on the grass, are swallowed by other sheep and develop. Many eggs and young adhering to excrement are by that means also dropped, and if the weather be damp vitality may be retained for weeks. Therefore, every animal known to be infested should be retained on the pasture, or, better, slaughtered, and the sound ones removed to pastures on which no infected animal has been. The infected land should be cultivated a year or two before returning it to pasture.

I will add that before the disease is developed, if the presence of parasites is suspected, there is a possibility of destroying them by a generous use of salt, sulphur and pine tar or turpentine internally, and inhaling sulphur fumes amd turpentine vapor. The parasites are usually enveloped in mucus, which, in a measure, protects them from the vermifuge. Bi-carbonate of soda is a good solvent for mucus and should be given with the other drugs to enable them to reach the enemy.

To give the description. technical names, and life history of the entozoa causing so much loss of life in flocks and herds would require a large volume which few would have time and patience to read. Hence it was thought best to give the farmer in plain language, in a short tract. a general idea of the character of his enemy, where to find him, and how to escape his ravages.

D. L. PHARES.

APPEXDIX.

Since the above was written specimens preserved in alcohol have been received of Mr. T. G. Smith-Vaniz, of Madison county, Miss., and drawings made, as seen in Figures 1 a, 2 a, 2 b, and 4, 4, on the plate. A large number of 1 a were found in sheep's lung. They sometimes infest the trachea or plug the small bronchi. The Tricocephalus affinis infests the large intestine, but not in large number. Strongylus micrurus is the lung worm of the calf.

Sulphur, salt and turpentine introduced into the stomach are valuable remedies for all these worms. For those infesting lungs and air passages, inhalations of sulphur fumes, turpentine, chloroform, carbolic acid, spraying with these substances, even injecting into the windpipe; turpentine, dilute carbolic acid, salt water in small quantities. In whatever way given they should be preceded by solution of bicarbonate of soda to dissolve mucus and give the vermifuges access to the parasites. With hypodermic syringe piercing between the cartileges these drugs can be safely injected in small doses.

DESCRIPTION OF FIGURES.

Figure 1 a.—*Strongylus filaria* from lung of a young sheep that died March 5, 1889. Some of the worms were full three inches long. The drawing shows natural size of one taken at random from a large number in alcohol.

Fig. 1 b.—Female *strongylus filaria* greatly magnified, copied from Second Annual Report of Bureau of Animal Industry, 1885, *a*, mouth; *b*, funnel shaped insertion of œsophagus into intestine; *c c*, intestine; *d*, caudal extremity; *e*, vulva; *f*, *f*, uterus full of eggs; *g*, shows a gap where part of the body is not drawn for want of room.

Fig. 2 a.—*Trichocephalus affinis* from a lamb, May, 1889, natural size.

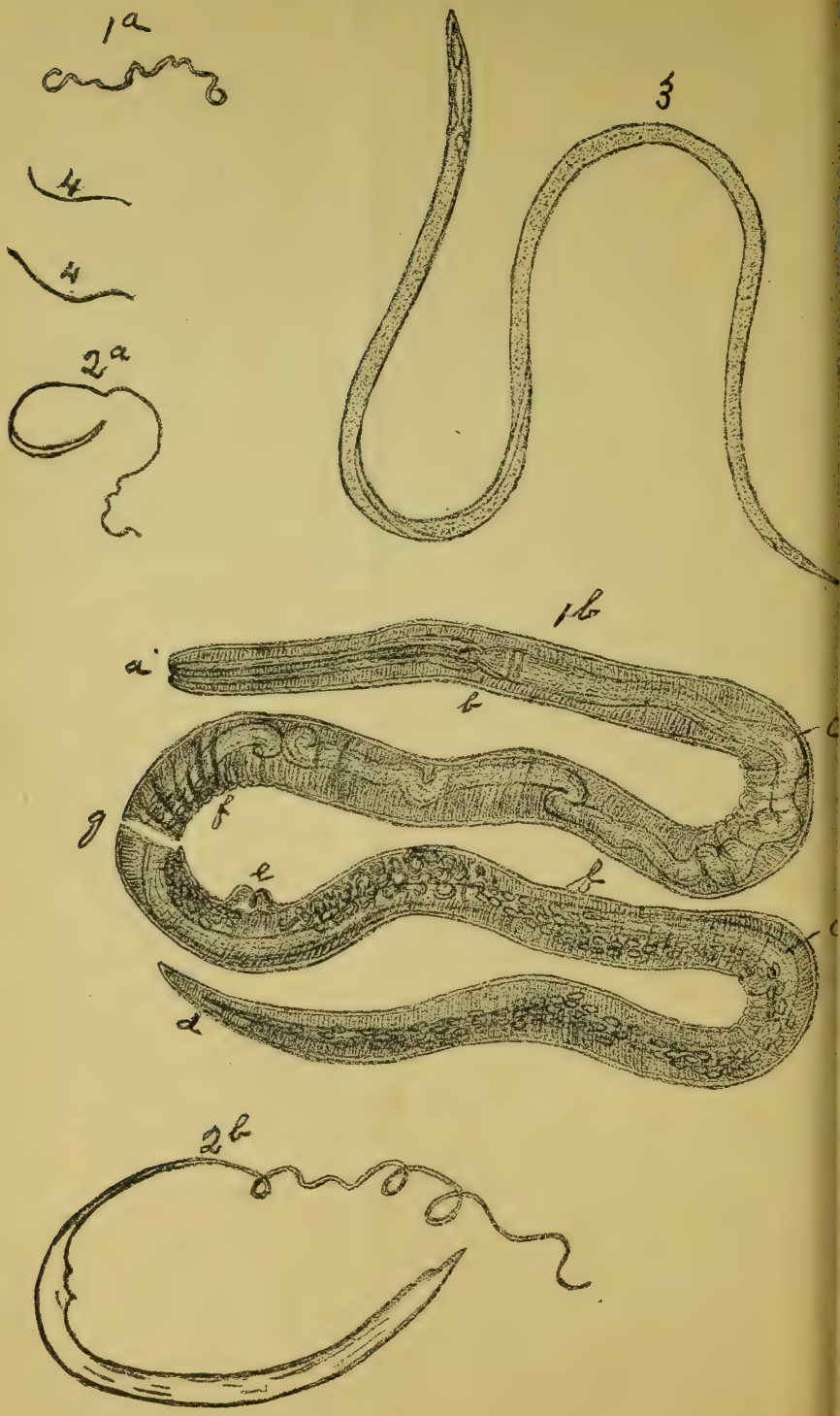
Fig. 2 b.—The same magnified.

Fig. 3.—Female *Strongylus micrurus* filled with eggs, magnified four diameters. Copied from same Report as Fig. 1 b.

Fig. 4 4.—*Strongylus contortus* from fourth stomach of a young sheep, December, 1888, natural size.

D. L. P.

June 20, 1888.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HELENIUM AUTUMNALE.

"False sunflower, sneezewort, sneezeweed, swamp sunflower, yellow star, ox eye. *Ord Compositæ.* An indigenous herb, with large golden yellow compound flowers which appear in August. All its parts are bitter and somewhat acrid, and when snuffed up the nostrils in powder are powerful sternutatories. Nine different varieties of Helenium have been described, but *H. autumnale, H. parviflorum and H. tenuifolium* are best known; the last two for their peculiar deleterious effects on the nervous system of the lower animals especially."—Dunglison's Medical Dictionary.

The number of species is much greater than here stated. The last seems to exert no deleterious effect on the nervous system of the cow and sheep, nor of any other animal, so far as the writer and many friends have observed for forty-six years. It is the bitter weed of the gulf States, and causes the milk of cows eating it to become very bitter; sometimes the butter is also bitter; and often the beef and mutton are bitter. Those tasting the bitter cooked flesh have sometimes become frightened and called a physician to investigate supposed attempts of cooks to poison a family. But this plant seems to be harmless to man and beast. Indeed, it seems to have a good tonic effect on cattle in the spring, and certainly promotes digestion in at least a certain proportion of people. It is a pure bitter, without acridness.

But the *H. autumnale* does injure and kill some of our domestic animals. It is distributed in damp and siping lands from near the great northern lakes to the vicinity of the Gulf of Mexico, and commences blooming late in August and continues till frost. The other species bloom earlier, the entire blooms being bright yellow, while the central portion of this is purplish. While the others are annuals, this is perennial; the root and lower part of the stems survive through the winter. The stems do not branch so near the ground as the others, and the plant is acrid, pungent. In common with the other species, it is also bitter. But the degree of bitterness and acridness is very variable. Within an area of a few square yards plants may be found with these properties very strong, and others in which the bitter is weak and the acridness scarcely perceptible.

EXPERIMENTS.

A series of experiments was commenced at the College in Oc-

tober, 1888, for the purpose of studying the effects of this plant on animals and of discovering antidotes. But neither subjects nor a supply of the green plant could be obtained, and only a few experiments were made on calves, kindly furnished by Prof. Irby.

Experiment 1—Calf about four months old and not fed in the morning. Upon three ounces of the dried plant was poured a pint of boiling water. After an hour the water was decanted with pressure. Mr. J. W. McWilliams, of the senior class, gave all the doses in all the experiments and noted the symptoms. October 6th the above infusion was ordered to be divided into four parts and one part given every half hour, beginning at 11:10 A. M. The first dose produced no very marked effect – only a flow of a few tears. After second dose became restless, later laid down. After third dose breathing impaired, continues lying down and appears sicker for a short while. Fourth dose, breathing harder, but at 3 P. M. the calf was resting easy. Next day he seemed to be nearly as well as usual and took his feed.

Experiment 2—October 13th; same calf. A hot infusion of six ounces of the drug was prepared in one quart of water and given between 8 A. M. and noon. Soon after the first dose some weeping began, but no other marked effect was observed. After second dose the calf laid down. Third dose, he continues down, but somewhat restless and sick. Fourth dose, becomes very restless, bowels loose, staggering, and very sick, holding head down, sucking wind, left flank tympanitic but not very tense, right flank contracted, trying to put head between forelegs, and very sick greater part of the day; movements weak and uncertain, purposeless, hyperesthesia very marked, especially along the back, shrinking from least touch, but by persistent handling submits to touch, respiration and pulse quickened, appearance of slight spasm along the back, neither eats nor drinks of food and water and milk in his stall, a little straw from floor in his mouth, and although the jaw is in constant motion the straw is undisturbed and he seems unconscious of its presence. Next day apparently well.

Experiment 3—October 20th; another calf about four months old. One pound of the dry plant was taken, one gallon water poured on it and boiled down to a quart; all given by 10:35 A.M. After third dose the left flank tympanitic, feces and urine discharged, slight jerking as though chilled, tremor of muscles of hindquarters, lying on right side over an hour, breathes with some noise and distress, very sensitive from withers to sacrum; at 11 o'clock fullness of left flank subsided, limbs showed weakness and later stiffness, very sick, frothing at mouth and flow from nose. Next day the calf was well.

The large quantity of the drug given this calf producing little more effect than the smaller dose on the former one leads me to suppose that the prolonged boiling may have dissipated a portion of the poisonous principle. Knowing that none of the symptoms

observed would lead on to death no antidote was administered in any of the experiments. The weeping and movement of the jaw were probably due to the pungent effect of the drug on the throat and stomach; and I incline to the opinion that the nervous symptoms were not caused by direct action of the drug on nerve centers, but were reflexes from the irritated throat and stomach.

In the sheep the spasms in severe cases are epilepti-form and a sheep may have many such convulsions and yet recover without treatment and after many hours rise up and walk.

The horse and mule succumb to the baleful effects of the poison quicker and more completely than other animals. The effect is manifested very soon after ingestion and with great violence. The animal cannot control his motions, plunges about blindly, falls dead or perhaps breaks his neck in falling forward with the head under the body.

An antidote which has proved effective is a pint or two of melted lard poured down the animal's throat. The relief is very prompt. But it must be given before the horse loses control of his limbs, or it cannot be administered at all. The relief is so prompt and complete that it is difficult to believe that it is the direct effect of the lard on the nerve centres, but as a local emollient applied directly to the burning throat and stomach. The local trouble being quickly relieved, the violent reflex effect on the nervous system suddenly ceases.

When we consider the wide distribution of this plant and that in some places it is so abundant as to hide the earth from view over whole acres, it is remarkable that so few poisonings occur. But animals have no special fondness for it. When they have been long on the road and deprived of green food, stopping where this weed is found and other green plants scarce, they are disposed to eat a little of it. It is under such conditions that the plant is most frequently eaten and the poisoning occurs.

Animals, notably sheep, once intoxicated by the plant and recovering, seem to acquire a mania for it, and when finding themselves in localities where it grows hurry to and devour it.

Within 200 miles of the Gulf of Mexico the *H. quadridentatum* takes the place of the preceding, is very abundant, harmless, blooms early and dies by August.

The Plate illustrates parts of the *Helenium autumnale*, or poison sneezeweed.

Figure 1 is an enlarged disk floret showing calyx, corolla, bifid stigma, below which the cylinder or tube of anthers enclosing the style.

Figures 2, 2, enlarged disk floret buds.

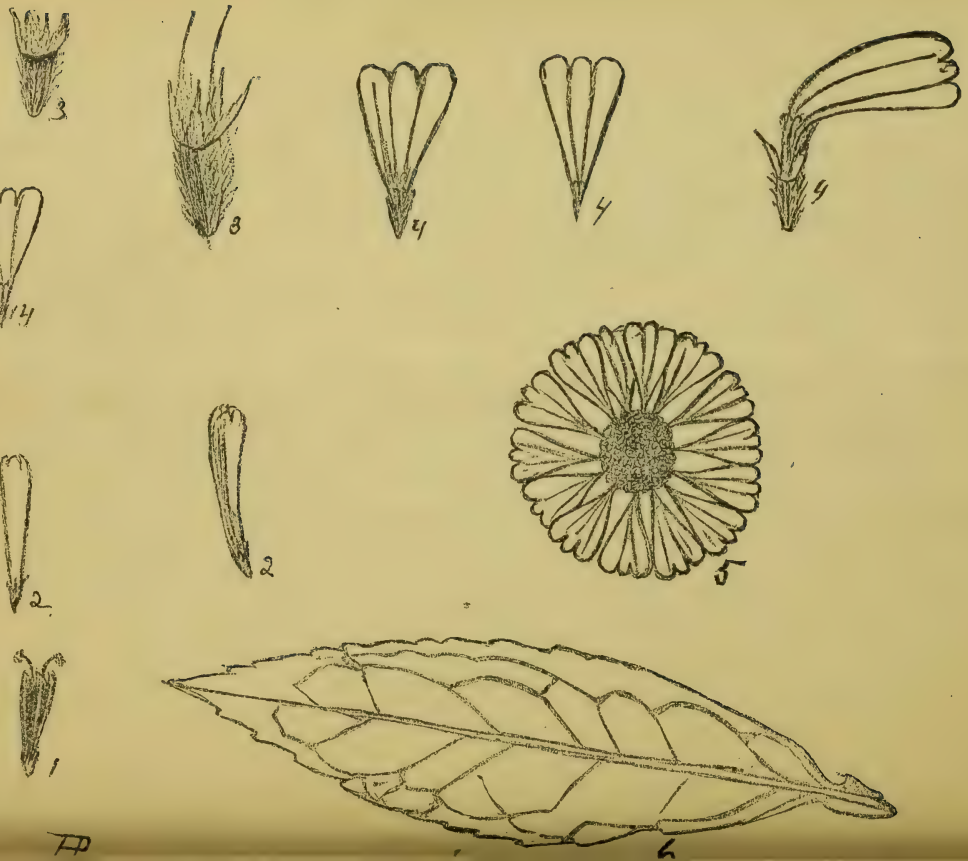
Figures 3, 3, magnified top-shaped, hairy achenia with denticulate, awn-pointed pappus.

Figures 4, 4, 4, 4, magnified ray florets with three cleft corolla.

Figure 5, head a little enlarged, showing 14 ray florets.

Figure 6, the irregularly dentate leaf, natural size.

D. L. PHARES.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MISSISSIPPI

AGRICULTURAL EXPERIMENT STATION,

BULLETIN, NO. 10.

DISHORNING.

D. L. PHARES,

VETERINARIAN

Agricultural College, Miss.

OCTOBER 10, 1889.

NOTE—Dr. Phares resigned on June 30, but as this Bulletin was prepared by him, while a member of the Station force, it is published in his name.—DIRECTOR.

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The Bulletins of the Station are sent free of charge to all persons in this State who apply for them.

DISHORNING.

For this spelling the reader is respectfully referred to all the dictionaries and encyclopedias.

ANATOMY OF HEAD.

A few words on the anatomy of the head of the ox will enable us to understand better the relations of the horns to the other parts of the head and the consequences of removing these appendages.

CAVITIES.

Although the head of the ox is very large, the brain being small, the skull or bony box containing it is also very small. The skull has a number of large bones appended and extending far away from the brain. These large bones contain large cavities filled with air; thus while the bones are widely extended and with many depressions and protuberances afford attachments for very large muscles, the head is comparatively light. There are ten of these large cavities, or rather twelve in pairs, besides that containing the brain.

There is no connection between any of these paired cavities and the deeply-seated skull or brain cavity, which is traversed by the median plane.

These cavities are named from the bones containing them, viz:

First. The inferior maxillary cavities, lying on either side of the median plane, have no opening into any of the others. The remaining pairs also lie on each side of the median plane, and all on one side of the plane have openings from one to another and into the great nasal passages, thus allowing circulation of air through all these cavities.

Second. The great ethmoidal cavities.

Third. The sphenoidal cavities.

Fourth. The superior maxillary sinuses.

Fifth. The frontal sinuses in the frontal bones.

Sixth. The sinuses in the cores of the horns. These last may be regarded as (and they are really) only branches or lateral prolongations of the frontal sinuses.

FRONTAL BONE.

The frontal is the largest, hardest, heaviest, broadest bone of the head and rises from three to five inches above the brain, the widely separated superior angles affording ample bases for the horns. These sinuses are very large, branching into many rooms, galleries and niches of very varied shapes. Besides these large cavities there is a large number of small cavities, tunnels, etc.

EXPERIENCES AND REPORTS.

The writer has been familiar with the operation of dishorning from his earliest remembrances; and during the last three years he has examined cases and reports of cases more than 10,000 in number, besides dissections of heads and brains of slaughtered cattle.

Recent investigations have been conducted at the College, with the object of ascertaining proximately at least the period at which absorption of the bone or cartilage at the superior lateral angles of the frontal bone takes place so as to elongate the frontal sinuses into the horns. This varies with breed and other conditions. It may be stated in a general way that this absorption takes place when the calf is five or six months old and the horn two or three inches long. If the horn be severed when the calf is six months old it will be discovered that in most cases the frontal sinus is opened by the operation. The cavity continues to elongate in proportion to growth of the horn.

It may then be affirmed that sound adult horned cattle have normally

HOLLOW HORNS,

that this is not caused by disease, and that there is no disease properly so called. As in man, catarrh sometimes extends into the frontal sinuses, causing much distress, so in oxen the inflammation sometimes extends through the frontal sinuses into the horn cavities—in both classes of subjects, in some instances, resulting in suppuration and caries.

WHEN AND HOW TO DISHORN CALVES.

At the place where the horn is to come the young calf has a small, button-like, hairless spot, easily seized and moved with thumb and fingers. After a few weeks a small tubercle may be felt under the skin ; now absorption has commenced on the inside, extending the frontal sinus, and deposit is taking place outside under the skin and a core for the horn has commenced forming. Now is probably the best time to dishorn and a pocket knife or scalpel is a convenient instrument for performiug the operation. The bald skin with a border of one-fourth of an inch wide of hair-covered skin, together with the cartilaginous button or tubercle beneath, may all be easily severed with a single cut and in a moment. But a few drops of blood are lost, the periosteum which secretes the bony core and the portion of skin which secretes the horn are removed with little pain to the calf and in a few days it is well.

DISHORNING OLDER CATTLE—ILL EFFECTS.

The operation, however, may be performed on animals of any age with little danger of serious injury. So far as pain and danger are concerned, the section may be made at any distance from the skin. But other considerations determine the place of section. As a rule, the nearer the head the better. Notwithstanding the assertions of many that the operation never injures the animal and never endangers life, we have too much testimony from the best surgeons and have had too many calls for assistance to accept the statement.

HEMORRHAGE.

In some instances the hemorrhage has been very large, extremely prostrating and requiring most active and skillful treatment to arrest it and save life. Fever has followed, loss of appetite and flesh, with slow recovery. It is true such cases are rare, yet as they do occur, every care and precaution should be observed to give the animal the best chances. We are convinced that we have seen instances in which, if death has not been absolutely caused, it has at least been hastened by the operation.

SUPPURATION—CARIES.

Without great loss of blood, there have been many cases in which there have been some fever, nervousness, dimin-

ished appetite, flesh and milk. It is not a very rare thing for some suppuration to occur after operation; and more rarely caries of the bone gives trouble for months, with offensive discharges.

ONE ARTERY.

Hemorrhage is from one artery—rarely two—situated at that part of the stub near the ear. Hence it will be perceived that plugging the sinus through which one sees some inches down into the head is worse than useless for stopping the flow of blood. But solution of persulphate of iron (Monsel's solution) thrown into the artery or introduced with a glass point instantly forms with the blood a firm clot or plug. The flow may sometimes be arrested by compress and bandage around the head above the ears.

HORRIBLE WOUND.

When a large horn is removed a frightful, large raw surface is left, and in its middle a huge cavern extends down into the head. One may see into this cavern several inches; the polished white walls reflecting the light well illuminate its interior. Some operators have mistaken this white surface for brain, and declare that they cut off the horns down to the brain; others within an inch of the brain, exposing that important organ to view. This, if true, would be horrible, and render the operation many thousand fold more dangerous and cruel.

NO REASON FOR HORROR.

A moment's glance at the anatomy of the head given above will show the absurdity of such assertions, and that a belt three inches broad, including the entire top of the head may be removed without touching the brain.

NOR SILLY SYMPATHY.

Equally absurd is the twaddle about the cruelty of cutting through the exquisitely sensitive marrow of the horn core. Nothing could be more useless or out of place than marrow in the ox horn.

HORN STRUCTURE.

The formation of the core has been explained. Now a word about its covering—the horn proper. This is of about

the same character, chemically, as hair, hoof or nails. It is secreted or formed in about the same manner. In the horn of the calf, when but two or three inches long, elongated bundles resembling masses of aggluinated hairs are as readily perceived as the bundles of fibres in boiled lean beef.

HORNS LITTLE SENSITIVE.

A number of organs are wisely formed with little or no sensitiveness, as liver, lungs, heart, brain, because in these sensitiveness would be much worse than merely useless, but absolutely pernicious. So the horn possesses no great degree of sensitiveness, being intended for great exposures, for hard usage and violent blows. There is no need, then, no place for the morbid, mawkish sentimentalism so much affected by writers and talkers on the subject of dishorning.

LOST BY ACCIDENTS.

Horns are often lost by various accidents. Not long ago, in the herd of the writer, a beautiful cow made a vicious charge with all her power upon another, who received the shock in such a way as to suffer no injury, while at the moment of collision a horn of the assailant was snatched off instantly, leaving the entire core uncovered. In a few weeks it was recovered with a layer of horn, but deformed. The next day another cow lost a horn in the same way. In some instances both horn and core are knocked off; and cases have been seen in which both horn and core were broken some inches from the head and required surgical aid.

USES, ABUSES AND DISADVANTAGES.

In many instances horns are ornamental, and in some countries, in a state of nature, useful to protect against the attacks of beasts of prey. But in domestication, protected from these dangers, the horns are well nigh or wholly useless to the animal. In a herd as a whole they are injurious, being employed to injure each other. They are often injurious to the individual. Finding that he has weapons with which he can assail others he neglects his legitimate business of grazing, browzing, taking water, and wastes time in teasing others and keeping them away from food and drink. He is all the time more or less excited and uncomfortable. So that his own well-being is impaired by having horns. Deprived of them he becomes quiet, not liable to violent excitement, eats, drinks, sleeps, enjoys contentment and grows fat. So much from his own standpoint.

MERCIFUL VIEW.

From the proprietor's standpoint: The horns of the stronger are a terror to the weaker animals, which are deterred from food, drink, rest; persecuted, gored, bruised, excited in a tyrannical, cruel manner, appealing powerfully to the pity of the merciful owner for relief. "For the righteous man regardeth the life of his beast." These considerations justify the removal of all horns.

FINANCIAL VIEW.

But man is financially interested in the matter. Since dishorning is really a merciful procedure, he should have no scruples about resorting to it to protect his property and promote his interest. He prevents these animals from wounding and bruising and famishing one another, saves a vast amount of time in handling, of room in sheltering, and of feed stuff. His beeves are fatted for market with much less expense of feed and in less time. They go into the markets, as attested by the dealers at the great cattle depots, in much better condition, having whole hides and unbruised flesh, both of which sell more promptly and at better prices, while the cost of transportation of the live animals is much less, because a large number can be packed in each car. For like reasons the milk, cream and butter product is increased in quantity and improved in quality. It is true that the product is in some instances slightly reduced for a few days after being dishorned, but after the excitement passes off and the wounds heal the beneficial results are permanent.

SANITARY.

The operation should be performed when the animal is in good, sound condition and plenty of good, wholesome food and water and good quarters accessible. The healing should generally be complete in from three to eight weeks according to size of the wounds. Usually no application to the raw surface is necessary except pine tar.

LOOSE HORNS.

Sometimes we find horns jointed on the frontal bone, or only partially united with it, and in other cases there is no bony union at all with the frontal bone. In the latter case the horns are pendent, may be easily moved with the hand, and readily severed from the head with a knife.

INSTRUMENTS.

The only instruments needed to dishorn are a knife and saw. The blade should not be too long and limber. Some of the butcher's saws or tenon saws, with reinforced back, are excellent. The saw should be plied with rapid, long strokes. A punch or gouge is not necessary in operating on young calves. There is danger in gouging away bone of opening the frontal sinus, which must be reclosed before healing can be completed. The cutting out of bone with the gouge really delays the cure.

NEEDLESS CAUTION

"One assertion has been made which, if it can be proved, will settle the matter as regards bulls. It is that in some cases they are rendered impotent—of no use as breeders."—Am. Dairyman. This cannot occur as a direct or even as a remote necessary effect. The bull and jack are not very rarely rendered impotent by becoming too fat and want of exercise. After dishorning if the bull becomes very quiet he may take on more than a normal quantity of fat, and so become impotent. This, however, is not likely to occur. But if it should, whether he be horned or doddy, work will restore his powers. Long experience in working bulls convinced me that they should all be made to work at least enough to pay for all the care and feed given them.

FASTENINGS.

Calves that can be conveniently held by two or three men may be operated on most rapidly by laying them on a platform of convenient height, or on the ground, and while firmly held by hand the horns removed. Younger ones may be held between the man's legs, his hands grasping the ears, while the operator with a knife in a moment removes the the betton as before described. I do not approve casting the older, stronger animals, they are so often injured by it; violent struggling is always a concomitant, and much time consumed. A narrow stall, with very little labor, can be turned into a kind of stocks in which an animal may be quickly and firmly fastened by a bar across resting on the loin or hips, another behind the hams, one touching the front of the thigh and the belly, and another against the breast. His body is thus rendered almost immovable, and it remains only to fasten the head to an immovable post in front. When the horns are removed and the stubs tarred, the animal may be released in a few seconds.

OTHER MODES OF OPERATING.

The use of caustic alkali or strong mineral acids to destroy the matrix and budding core, if producing suppuration or open sore, is more cruel and less cleanly than the knife or the hot iron. The iron, heated to right temperature, and skillfully applied, causes pain of a second's duration and makes a dry crust which slips off in about two weeks, scarcely leaving a scar.

D. L. PHARES.

EXPLANATION OF PLATES.

In all the plates the darkest shadings indicate very deep or elongated cavities, the lightest shading very shallow excavations, and the white parts the bony core. The specimens from which the drawings were made were selected from a lot of horns removed from the College herd by Professor Irby, April 6th, 1889.

It is to be regretted that no drawings were made of buttons and tubercles cut with a single stroke of a knife from the heads of young calves the same day.

Plate I, represents sections of a pair of horns of a 6-year old cow. These figures show great differences in the size, shape and number of cavities in the horns of the same cow. Usually but one cavity extends far into the core, others uniting with it one or two inches irom the base.

Plate II, figure 1, shows the longitudinal sinus and a shallow depression in the horn of a 6-year old cow. Figure 2 shows a contracted pass in the cavity an inch from the head of an old bull. Each side of this narrow channel the cavities are large. The section was made of the left horn, an inch from the head, the right having been broken off about that length two years before. All the figures are natural size, and it will be observed this horn is small.

Plate III. These three figures represent horns of calves about six months old.

Figure 1 shows a large but shallow extension of the frontal sinus into the horn.

Figure 2 shows a smaller, shallower extension, indicating that absorption had passed the plane of section but a few days.

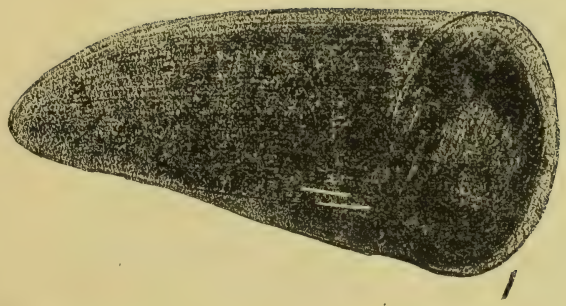
Figure 3 shows a core in which absorption has not quite reached the plane of section. The section shows an unbroken, uniform plane surface. A week or two later removing the horn, the frontal sinus would have been exposed to view and the air perceived passing through the opening.

These three figures exhibit true to nature the fibrous structure of the horns.

CORRECTION.

In Bulletin, No. 9, under Helenium Autumnale, page 11, line 11 from bottom, instead of "purplish" read "paler and soon turning brown."

D. L. P.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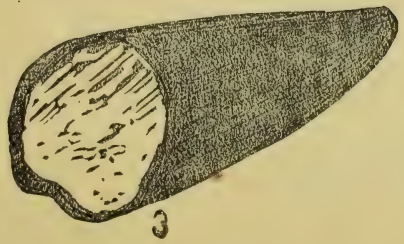
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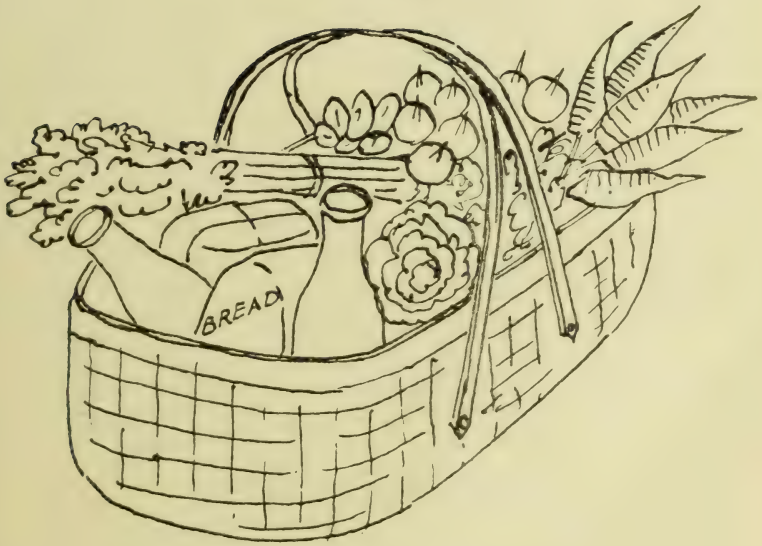
Bulletin No. 10 **January, 1929**

MARKET BASKET WISDOM

By

Dorothy Dickins



Mississippi Agricultural Experiment Station
A. & M. College, Mississippi,
J. R. Ricks, Director

MARKET BASKET WISDOM

By Dorothy Dickins

Filling the family market basket is an ever present question. For the city housewife, it means making every penny count. For the rural housewife, it means making every minute count.

Mr. Jones of the city makes just enough to buy bare necessities for his family. Rent must be paid in order that the family be housed. A few clothes must be provided for the father and the children so they may go to work and to school. The only place to cut is on the food. Mrs. Jones, not understanding all she should about food values, makes these cuts on the most necessary foods. For instance, she considers milk at 17 cents a quart too expensive yet often buys meat at 30 cents a pound.

On the other hand, Mr. Holcomb from the country makes much less in actual cash than does his city friend. He can, however, provide his family with a good diet at much less cash expenditure, for he has land at his disposal for producing such a diet and obtains a few foods practically as a by-product of his general farm business.

This bulletin will tell how Mrs. Holcomb, a typical housewife of the rural areas of Mississippi, filled her market basket.

Adding to Family Wealth

Mr. Holcomb owned two milk cows. These were freshened six months apart, in fall and spring. Thus, an ample milk supply was insured. In fact, a surplus was produced, part of which was fed to animals, part sold.

A flock of 55 fowls, including young chickens, furnished this family with their egg requirement and some surplus from February through August. However, less than the requirement was produced in fall and winter. Better selection and care would, doubtless, have meant more eggs and

chicken for family consumption, more for sale.

Mrs. Holcomb canned, preserved, jammed, jellied, pickled, and dried enough food stuff to provide about 3 quarts of food per week throughout the year for her family. Considering the long growing season and the short mild winters of Mississippi, this supply was probably great enough to supplement the supply of fresh foods which could have been obtained from the farm.

The Holcombs, however, have a very unsatisfactory garden. Mr. Holcomb excuses himself by saying that it is not worth the work that it takes. We know, of course, that this is not true. A garden with reasonable management is certainly worth what it costs. In fact, one can cite numbers of instances in which very large quantities of vegetables have been produced on small plots of land. Mr. Aser of Choctaw County, has a garden of 1½ acres. Last year it cost him, counting the labor, seed, fertilizer, use of land, and horse work, $47.57. He supplied his family of four with vegetables throughout the year and sold $82.20 worth. Mrs. Holcomb says, "A garden is a good thing but it takes all Mr. Holcomb's time to work his crop." We know that a garden can be cared for at times when the work interferes very little with regular farm or home duties. Mr. Randle has a successful garden. Yet, he gives an average of only thirty minutes a day to its cultivation.

The Holcombs have only three fruit trees. These do not produce sufficient quantities of fruit to last throughout the year. A well planned orchard is as necessary as a well planned garden. Proper care of this orchard is also essential, for production decreases when one neglects pruning and spraying. Fruit is a food, not a knick knack to be eaten between meals. Therefore, it behooves Mrs. Holcomb to provide an adequate supply, which includes preservation as well as production.

This family raised and killed enough hogs to provide lard and salt meat for the greater part of the year, but depended, largely, on the town market for their fresh meat supply. The butcher shop bill might have been saved or, at least, reduced by making greater use of unprofitable

milk cows, calves not needed for dairy purposes, and culls from the poultry flock.

Valued at retail selling price, the foods raised on this farm and eaten by this family were worth around $39.00 a month. However, the question of variety is one of greater importance than that of value. This means that the Holcombs should budget their time among the various food products, allowing a generous share for the garden and orchard.

Food Costs

This family consisted of a father, a mother, a boy 16 years of age, and two girls, 12 and 7 years of age. They consumed about $53.00 worth of food per month, which is equivalent to about 35 cents per man per day.

Money value of foods used by the Holcombs during the first two weeks in November:

Foods Purchased		Foods Furnished by Farm	
Apples	$.35	Blackberries (c)	$.50
Beef	.55	Chicken	.92
Baker's Bread	.30	Eggs	.87
Cabbage	.25	Turnip Greens	.44
Cheese	.35	Lard	1.45
Cornmeal	.74	Whole Milk	10.08
Flour (white)	2.00	Molasses	.71
Sardines	.10	Peaches (c)	.50
Pork	1.25	Peanut Butter	.35
Sugar	.68	Peas (d)	.18
		Pickle	.30
Edible food from this supply fed to animals		Salt Pork	1.04
		Potatoes (Irish)	.30
Buttermilk	2.90	Potatoes (sweet)	1.00
Cornbread	.20	Preserves	.42
		Sausage	.62
		Squirrel	.30
		Tomato (c)	.50
		Turnips	.55

One of the usual methods of valuing home grown products is to use retail selling price in town. This method is used as it gives a good basis for comparing foods purchased with those raised at home. Yet, it results in the money

value of a dietary appearing higher than it really is. In all probability the Holcombs would never have paid $7.18 in cash for milk and milk products, or 50 cents for canned blackberries.

The food supply of this family furnished all food needs with the exception of iron. A more generous use of vegetables and fruits and part of the money used for white flour spent for whole grained foods would have taken care of this deficiency. A little more time in the garden with no more cash expenditure would have given an adequate dietary.

Indeed, it is possible to provide an adequate dietary for much less cash than was expended by Mrs. Holcomb. Mrs. James, for instance, spent only $2.21 in cash during a period of two weeks in November. Yet, her dietary was adequate. She purchased sugar, rice, flour, and grits, and obtained milk, eggs, vegetables, fruits, molasses, meat, and lard from her farm. Filling the market basket is then as much a question of what one produces as it is a question of what one spends.

One may purchase a variety of foods and yet have an inadequate dietary. One may purchase only 2 or 3 foods and yet have an adequate dietary. This fact is brought out by a tabulation of foods purchased in February and in November by Mrs. Gay. In February she raised a quantity of food at home, by November she had moved to town and had to depend on the grocery store.

Foods Purchased by Mrs. Gay in February (2 Weeks)		Foods Purchased by Mrs. Gay in November (2 Weeks)			
Flour	$.64	Meal	$.29	Bread	$.20
Meal	.41	Flour	.70	Eggs	.25
Sugar	.22	Sugar	.54	Turnips	.15
		Cakes	.25	Salmon	.35
		Corn	.40	Salt Pork	1.00
		Lard	.75	Crackers	.20
		Butter	1.20	I. potatoes	.25
		Buttermilk	.80	Beef steak	.40
		Oysters	.65	Pork & beans	.15
		Cheese	.35	Pork	.50

In spite of the small amount of food purchased in

February Mrs. Gay's dietary was more adequate than in November, the month she purchased a large amount.

Rural families raising little food at home rarely get an adequate dietary. In theory it is possible for them to live adequately from paper sacks. In practice those raising little at home are families with too little cash to purchase a sufficient amount and variety of food to supplement the supply raised at home.

Meat and Fish

In the period of two weeks mentioned, the Holcombs consumed only $3.12 worth of meat. This supply included pork, chicken, beef, squirrel, and sardines, a large part of which was purchased.

To supply pork and pork products for the average farm family, at least, one pig should be raised per adult person or equivalent. This would provide around 150 pounds of pork products per adult, enough for the family and a surplus for sale. In addition, the unprofitable milk cows should be turned into beef, calves not needed for dairy and breeding purposes into veal. Such a plan will result in adequate quantities of meat as well as an additional source of income. Because of poor facilities for keeping fresh meat, a large part must, of course, be cured and canned. Families desiring a fresh supply can well follow the community who planned for such a supply by organizing a meat club. The members took turns in providing animals for slaughtering, the different cuts of meat going to the different members in rotation.

The Holcombs or other families living on the farm should not have to depend so largely on the town for their meat supply. Meat can usually be produced on the farm more cheaply than it can be bought in town. Therefore, a plan should be worked out whereby a regular meat supply is assured.

This family did not use meat once a day. Meat is valuable in muscle building, in blood formation, and in stimulating appetite. It is, however, deficient in bone building

materials and in most of the vitamins. Yet, no one food is perfect in every respect. Meat should certainly be included in the family dietary but not too abundantly for excessive quantities are not easily cared for.

Where more meat than is needed is produced, it should be sold, not eaten. Indeed, when cash income is low and meat is produced in abundance, it would often be advisable to sell the more expensive cuts and use the cheaper cuts at home. There is little difference in the nutritive value of the different cuts. The housewife must, however, "adjust palate and purse so that each has its due."

Eggs

During this period of two weeks in November the Holcombs used a little over two dozen eggs, or about one-third of an egg per man per day. In spring and early summer they used more than the standard, an egg per man per day. A flock of 55 fowls should certainly produce an abundant supply of eggs throughout the year. That production is low in fall and winter is partly due to two facts, poor feeding and poor stock. The non-layers should be eaten, canned, or sold. The layers should be fed regularly and well. A surplus produced in fall and winter will bring in much more cash than a surplus in spring.

If Mrs. Holcomb had put away eggs in the spring when they were plentiful for fall and winter when they were scarce, her family would have had an egg per man per day. On the other hand, she could have purchased eggs when production was low. This, she rarely did.

A regular egg supply is important, for eggs are especially valuable in dietaries of children. It is as important in fall and winter when they are 40 and 50 cents a dozen as it is in spring when they are 20 and 25 cents a dozen. Therefore, Mrs. Holcomb should make provision for a regular supply.

Dairy Products

$7.18 or nearly 29 per cent of the total value of the

Holcombs' dietary went for milk and butter. This allowance provided around a gallon of milk a day and butter in generous quantities. Cheese was the only dairy product which was purchased. However, only 35 cents was paid for cheese. It is well that milk was so generously provided on this farm.

The secret of an adequate and cheap diet is plenty of milk. Milk is our cheapest source of muscle and bone building material. It is almost impossible to get sufficient quantities of bone building material without using milk. One authority says, "spend as much for milk as for meat, fish, and poultry." The milk and butter used by the Holcombs were worth more than twice as much as the meat they used.

Why is it important what this family or that spends for this food or that? Simply because expenditures among the various food groups affect the food value of a diet. A large percent of total expenditures for milk means a diet that is adequate in most of the nutritive factors.

Fats

The lard, salt pork, and sausage used during a period of two weeks by the Holcombs amounted to $3.11 or 12 per cent of the total money value of their dietary. In addition, there was butter for which we have no figures. This means that the amount of fat used provided more than the general allowance of three-fourths of a pound a week for adults and six ounces a week for children under ten years of age.

The quantity of fat used was largely due to habits of cooking and eating, partly due to the fact that farm families require more fuel foods than do families doing less strenuous work. It is probable that this family would have been better off from a health as well as a financial standpoint had they sold a part of this fat supply.

Grain Products

The Holcombs used only three foods from this group:

white flour, cornmeal, and baker's bread. All three of these foods were purchased. Flour was, however, used in larger quantities than was cornmeal. Very little baker's bread was used.

These three foods are among the lower priced cereals or grain products. For instance, a package of four ounces of ready-to-eat cereal may be obtained for 15 cents or one pound for 60 cents. A pound of cornmeal may be obtained for a little over 3 cents. Yet, they yield about the same amount of fuel.

Cereals furnish more fuel for amount expended than do any other class of foods. In this dietary they furnished one-third of the fuel for one-tenth of the money value.

A high cereal diet means a cheap diet but why should this family live on a diet similar in a number of respects to that of Mrs. Jones from the city? The Holcombs can more easily afford from the standpoint of health and finances to put labor into raising vegetables than they can to put cash into purchasing cereals. More starchy vegetables and less flour could have been used. This would have meant a dietary which provided a greater margin of safety, a dietary with less cash expenditure.

Whole grained cereals are especially important in diets where cereals constitute more than one-fourth of the fuel as did Mrs. Holcomb's. Therefore, it is a pity that unbolted meal, a cheap and easily obtained whole grained cereal, was not used. Whole wheat flour and oatmeal are also cheap whole grained cereals. The use of such cereals at least once a day would mean a better diet, but not a more expensive diet.

Sweets

Sweets are also fuel foods. They owe their popularity to flavor. They furnished 13 per cent of the total fuel value of the Holcombs' dietary for 7 per cent of the total money value. This means that they are cheap sources of fuel. Sweets should not be used too freely in the diet. Too many cause digestive disturbances as well as create an ap-

petite for themselves rather than for other foods. 10 to 12 percent of the total fuel value of the diet from sweets, is a good rule to follow. The Holcombs' dietary furnished a little over this requirement.

Sugar, molasses, and preserves were the only sweets used. Around one-third of the sweet supply was purchased, the rest produced on the farm. Sugar is solely a fuel food, whereas molasses is a concentrated vegetable juice yielding bone and blood building material as well as fuel. Therefore, it is well that molasses was as generously used as sugar.

Preserves contain about two-thirds as much mineral as does the corresponding fruit. As previously stated, food produced on the farm was priced at average retail selling price in nearest town. Thus priced, preserves were a costly fuel. The food value obtained from preserves, jams, and jellies does not justify an excessive use in the diet. Used moderately as by the Holcombs, they have a distinct place in the family dietary, that of giving variety.

Vegetables and Fruits

Increasing the use of vegetables and fruits would have improved the food value of the Holcombs' diet in every point needing improvement. Vegetables and fruits rank next to grain products and milk in the formation of an economical and well-balanced diet.

Over three-fourths of the vegetables and fruits used were produced on the farm. This means that Mrs. Holcomb purchased very few of these foods. Fresh vegetables such as cabbage, lettuce, collards, turnips, beets, carrots, butterbeans, spinach, etc., can easily be grown in the month of November. However, only one or two fresh fruits are available at this time. For this reason, a well planned Mississippi dietary will always provide for the purchase of some fresh fruit at this season.

An increase in the use of green vegetables which are rich in iron and an increase in the use of raw vegetables and fruits which are rich in vitamin C would have meant

a better diet for the Holcombs. Such a diet could have been obtained without greatly increasing cash expenditure for food.

Getting Better Values

As previously stated, Mrs. Holcomb purchased the following foods: apples, beef, baker's bread, cabbage, cheese, cornmeal, flour, sardines, pork, and sugar.

This study came just before hog killing time and when egg production was low. Provision for such a time, as canned beef, culls from the poultry flock, or preserved eggs would have saved buying meat. Having made no such provision, Mrs. Holcomb did right in purchasing a supply, for meat has a place in the family dietary.

Cabbage was purchased which could have been produced on the farm. Chemical analyses have shown that the green cabbage usually found in the farm garden in richer in iron than the white cabbage which one generally buys.

American cheese as well as cottage cheese can be made successfully on the farm. During certain seasons, Mrs. Holcomb has an over supply of milk. Yet, she can find no market for this surplus of only a few weeks. A yearly supply of American cheese could easily be made at such a time at practically no cost except that of labor.

$2.00 was a large proportion of total expenditures for a food which adds so few food factors as does white flour. Satisfactory quantities might have been purchased for 75 cents. 50 cents of the amount saved could have been used in purchasing whole wheat flour, 25 cents oatmeal. This would have meant a better as well as a cheaper diet.

Perhaps, the same amount of cornmeal could not have been produced much cheaper on the farm. The same amount of cornmeal produced on the farm would, however, have given more food value, for much food value is lost when the bran and germ of the grain are removed.

In this State, it is possible to produce fruit only seven months in the year. The varieties most easily grown are

not those which will keep for several months. Storage facilities are generally poor. Therefore, for five months in the year one must largely depend on canned and dried fruit. The Food Habits Score Card of the Extension Division calls for fruit twice a day, one of which must be raw fruit or canned tomatoes. In order to meet the fruit requirement during the five months mentioned enough fruit should be canned or dried to serve fruit once a day, enough bought to serve fresh fruit at least three times a week.

Therefore, Mrs. Holcomb is to be considered wise rather than extravagant in purchasing apples for her family. Indeed, tripling her expenditure for fresh fruit would have been justified.

The only foods which should be needed to supplement home products are cereals, sugar, and fresh fruits (for a few months in the year). This involves only a small cash expenditure.

When families fail to take advantage of their land, it means either of one or two things, doing without or purchasing extra supplies. The first course is usually followed, for cash realized from the average farm is not great. Yet, it is better to purchase what the purse can ill afford than it is to do without what the body needs.

Table Waste

By table waste, is meant food not eaten. It may include plate scraps or edible food uneaten.

The percent of plate scraps varies from little or nothing to 20 per cent of the value of the dietary. Plate scraps amounted to 10 per cent of the value of the Holcombs' dietary. Better cooking, and serving to suit the demands of the individual appetite, would have meant a smaller amount left on the plates.

Mrs. Holcomb, by cooking food in amounts likely to be eaten and using leftovers at a later meal, kept down waste of edible food to the minimum. In two weeks time, there was only $3.10 worth of edible food not needed for human consumption. This was fed to chickens and hogs as were

plate scraps.

Table waste as long as it is composed of comparatively cheap foods makes suitable feed for animals. Foods like cornbread and buttermilk make healthy animals as well as healthy children. Therefore, the question of reducing table waste to the minimum is not so important to the farm woman who has productive animals to feed.

Food Value and Money Value

Low, moderate, or high cost dietaries can be planned but after all the most important thing for the rural housewife who secures a large part of her food without cash outlay is a dietary which is both adequate and palatable, one that meets the individual needs of her family.

A knowledge of food values combined with a generous supply of home raised products would make it possible for Mrs. Holcomb as well as other housewives to fill their market baskets adequately and cheaply.

MISSISSIPPI

Agricultural Experiment Station

BULLETIN NO. 11.

CHARBON

G. C. CREELMAN,

VETERINARIAN,

Agricultural College, Miss.

FEB. 15TH, 1890.

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The Bulletins of the Station are sent free of charge to all persons in this State who apply for them.

CHARBON.

(Bacillus anthracis.)

On June 11th, 1889, the Station received a telegram from Redding & Lear, proprietors of a livery stable in Yazoo City, stating that Charbon had broken out among the mules in that district and asking for assistance. I went immediately to the locality, and with Dr. Wray, of the United States Department of Agriculture, and Dr. Connoway, of the Missouri Experiment Station, remained there until the crisis of the disease had passed and the rainy season set in. Dr. Connoway remained there, inoculating and treating animals until August 3d, when he returned to his laboratory in Missouri and conducted a thorough pathological examination of parts of the diseased animals. Dr. Wray likewise conveyed specimens from animals that had died from the disease, to the pathological laboratories of the Division of Animal Industry of the U. S. Department of Agriculture, and of Johns Hopkins University. These examinations all terminated in one conclusion, that the disease was true Charbon, caused by the presence of a germ (Bacillus anthracis) in the animal body.

HISTORY OF THE DISEASE.

Charbon has a very ancient history, as we have accounts of it from Asia Minor dating as far back as the seige of Troy; and during the seventeenth and eighteenth centuries great destruction was caused in Europe by epizootic outbreaks of anthrax.—So prevalent was it in 1617 that in the neighborhood of Naples alone, 65,000 persons perished from eating the flesh of diseased animals. Between the years 1757 and 1800, six distinct outbreaks occurred in France, confining themselves to no particular class, all domestic animals being alike affected. During the early part of this century, the French people suffered very severely and have spared no pains to have the disease thoroughly investi-

gated. In this country, little has been done to check its ravages, but the losses in the swamp region of this State during the past season, have so seriously affected the planters in that locality, that a bill has been introduced in the present Legislature to provide for the appointment of a State Veterinarian.

CHARBON IN MISSISSIPPI.

In order to ascertain the extent of country affected by the disease, the Station issued a circular containing the following questions and sent some hundreds of copies to planters in the Yazoo Delta counties:

"1. At what date did Charbon make its first appearance in your locality this year?
2. Did horses, mules, or cattle suffer most?
3. What proportion of animals attacked recovered without treatment?
4. What remedies were most largely used?
5. What remedies were most successful?
6. How long did untreated animals usually live after being attacked?
7. What preventives were used; in what doses; and were they successful?
8. What kind of drinking water did the animals have before being attacked?
9. What is your estimate of the number of animals which died in your county?

Answers were received from sixty-five planters, representing the counties of Yazoo, Sharkey, Warren, Issaquena, Tallahatchie, LeFlore, Tunica, Holmes, Washington, Claiborne, and DeSoto.—From these replies, together with information received directly from the planters themselves the following facts were obtained:

In 1836, a disease then called "Choking Quinsey," affected the animals in the swamp region, and as the symptoms presented in these cases were identical with the symptoms of Charbon, we have no hesitancy in believing that this epidemic was true Charbon.

In 1865, many cases were reported but it was not until 1867 that the planters had occasion to become seriously alarmed.—The previous winter had been unusually mild and was followed by an early spring. The streams soon dried up and ponds became stagnant, the very grass wilted in many places and all the conditions favored the spread of the disease. What followed may readily be conceived. Scarcely a mule escaped its ravages, and ninety per cent of those affected perished, so fatal did it prove; and several years elapsed before the planters recovered from their heavy losses.

Since that time, it has prevailed more or less every year, always proving more virulent after a mild winter and warm spring.

he years '75, '76, '81, and '82 were marked by light epidemics on oth sides of the river. The past season threatened to be a repetition of 1867, but, thanks to the improved condition of the armers and a consequent improved condition of their stock; heir hearty co-operation in assisting us to carry out every deail; and the timely interference of Nature, by sending rain at he proper time, the calamity was to a great extent averted.

This year the disease first made its appearance in Yazoo county long the east side of Silver Creek, from whence it spread all hrough the low lands, always following the direction of the rivrs and creeks and doing little damage on the higher lands.

It confined itself almost entirely to mules and very few of the nimals recovered without treatment. Many different remedies ere tried, from burning with a hot iron, to drenching with salt nd water, but the one which gave the most universal satisfaction as that prescribed by the Station Veterinarian, Dr. D. L. Phares, s follows:

"4 Drachms of Potassium Chlorate.
1 Table-spoonfull of Tincture of Muriate of Iron.
Mix in a pint of water and give every four hours as a drench.
Bathe the affected parts in a solution of Carbolic Acid (1 to 8)."

This was printed and sent to all infected localities, and where he directions were followed in the first stages of the disease, carcely a case was lost.

CAUTERIZING.

We cannot condemn too strongly the inhuman practice of severely cauterizing the parts where the swellings appear. Even where animals recovered after this treatment, they were so covered with wounds and scars as to be totally unfit for work for many weeks. Such treatment is directed towards the effect, not he cause of the disease. The swellings are the effect of the blood changes, and the increased temperature of the animal which sometimes reaches as high as 105°) shows that the disease is general, and not local in the swellings. The disease however if inoculated by a fly, will start locally, in which case cauterization might be valuable. A still better method is to inject into the charbon swelling a dilute solution of carbolic acid (1 to 100). This gives no pain, is more effective, and produces no evil results.

THE HORSE FLY THEORY.

Many planters in the Delta region advance the theory that the disease is caused by the swarms of flies which infest that locality, and have designated a particular species of horse fly, which is very conspicuous in every outbreak, as the "Charbon Fly."—We gave the subject some study and made the following observations: In some parts of the country, and especially along the lower end of Silver Creek, horse flies attack the animals in such numbers as to leave upon the back, belly, and legs a thick mass of clotted blood. To one who has seen this, the poisoned condition of the blood resulting from the absorption of septic matters would not be surprising. Flies were caught that had filled themselves with the blood of a mule in the last stage of the disease. The blood, when examined microscopically showed the germs in great numbers. After the mule died, horse flies were caught from the carcass, and mounts from the blood gave the same result.—No germs were found in the blood-filled flies which had been feeding on healthy animals.

Bollinger, in writing of Charbon in Europe, observes that the disease is often most prevalent where flies are in the greatest abundance, and he has vaccinated the disease in rabbits by inoculating them with flies caught on the carcasses of animals that had died from Anthrax. He mentions that the flies however resist the influence of the virus although the bacilli are found in them. We conclude therefore that flies are active agents in disseminating the disease. The fact that the disease is due to the presence of a germ, that this germ is found in the blood of flies, and that these same flies cause the clotting of blood on the body of the mules, is strong circumstantial evidence.

NATURE OF THE DISEASE.

When first noting the symptoms of the present outbreak, we were of the opinion that it was not contagious, and might with good reason be pronounced *Purpura hæmorragica*, a form of malignant fever. That it was a disease principally affecting the blood was quite evident, but whether it was caused by a specific micro-organism, as the Bacillus anthracis, or from absorption of septic products, we could not determine positively without resorting to laboratory methods. Later pathological investigations

at the Department of Agriculture at Washington, and by Dr. Connoway, proved beyond doubt that the disease was the true bacteridean Anthrax.

SYMPTOMS.

Usually for some hours before the disease is manifested externally, the animal affected will appear languid, the ears droop, and signs of general depression may be noticed. Slight swellings soon make their appearance, these swellings are at first about the size of a walnut and may be simple or compound in structure, round or irregular in outline, but always adhering to a peduncle at the base. They are painful and the sensibility of the surrounding tissue is increased; when touched with the finger a local shivering, like a subcutaneous beating, is distinctly felt. They are variously located, but nearly always on the dependent parts, as under the neck and breast, between the front and hind legs, along the lower part of chest and abdomen, and on the sheath and teats. The sheath in some animals is so enormously swelled as to interfere with urination. We have seen but one case in which the swellings were on or near the back of the animal.—Nearly all animals not treated died in from twelve to thirty-six hours after the first symptoms were noted, the temperature rising to 105° before death.

POST MORTEM EXAMINATION.

The external swellings, which are the result of infiltration of serum into the areolar tissue beneath the skin, on being cut into, present a yellow jelly-like appearance. The blood in both the veins and arteries is black, fluid, and noncoagulable. The liver appears congested, the kidneys are softened, the substance of the organs giving away easily under pressure, and the capsule is easily peeled off. Internally they have a gray ashen appearance.—The loose tissue surrounding the kidneys is infiltrated with serum and black blood. The urine in the bladder is highly colored, but never sufficiently so to indicate disease, and in no case did we find any blood in the urine. The spleen usually undergoes little change, except in spots, where elevations, half the size of a hen's egg, of a soft puffy nature, may appear on its surface. These

spots on being cut into show a destruction of the tissue at these points. Black thick blood of the consistency of mush, escapes from these cuts. The lungs appear partially congested and collapsed, this condition being brought about by the pressure of the swellings on the larynx and trachea. In the heart and pulmonary arteries are yellow clots, surrounded by the same black fluid blood. The muscles which are attached near the swellings in some cases appear as if beginning to decompose, and are easily stripped from the bone, the periosteum coming off with the flesh. The mucous membrane of the stomach and large intestines never appeared to be much affected, but that of the small intestines was usually somewhat congested. The mysentary had an unhealthy yellowish appearance. The lymphatics were congested, and all the blood vessels distended with the black fluid blood. This blood, upon being collected in a jar, soon separated into two portions. The yellow fibro-albuminous elements collect at the top and coagulate, while the watery portion, holding in solution the soluble matters, remains at the bottom. A considerable quantity of the yellow water, of the same character as that which drips from the cuts in external swellings, is often found in the thoracic and abdominal cavities. This exudation is coagulable on exposure to the air, but while in the body always remains fluid. The ropy, frothy character of the urine shows that there must be a large quantity of albumen passed through the kidneys, therefore the changes in these organs are doubtless due to their efforts to throw off the sero-albuminous products brought to them.

PREVENTION.

In severe cases, where the disease is thoroughly established, medical treatment of any kind is useless. The disease germs are now lying dormant in the infected district, ready to produce another epidemic when the proper conditions are supplied. It is interesting to note that the plantations which suffered most in 1867 have been the heaviest losers ever since, while the new plantations in the same localities, where the animals were not allowed to wander about, are practically free from its ravages.—If then, the disease is already there, we must so modify the conditions as to prevent its breaking out. The following conditions

found in the Delta during the last epidemic show that very little was done in this direction:

1. Diseased animals, no longer fit for work, were turned out on the roadsides, or allowed to wander among healthy herds.

2. On Silver Creek, hundreds of animals drank from, and waded into the stagnant waters through the entire season.

3. Diseased and healthy animals of the same herd were frequently watered from the same trough.

4. In most instances, all the mules of one plantation were fed corn from a common trough.

5. Work animals were allowed to graze at night, in pastures which diseased animals had formerly used.

6. Many of the working mules were so poorly fed and cared for, that the system, already broken down, was rendered easily susceptible to any disease.

7. Seldom was anything done to repel the attacks of the myriads of flies.

8. The carcasses of animals that had died from Charbon were, in many cases, allowed to remain for days just where they happened to be when death overtook them.

9. Disinfection was almost unknown.

We urge the hearty co-operation of planters in a thorough disinfection of every plantation that has ever been visited by the disease. In order that the process may be properly carried out, we suggest the following points:

1. In all cases there should be a thorough disinfection of the premises. The stables should be frequently white-washed, and all discharges from the animals deodorized by the use of sulphate of iron (copperas), which is a cheap and efficient agent for the purpose. Dissolve one pound in a bucket of water, sprinkle it about the floor of stable. The sheds should also be fumigated with sulphur twice a week. The doors should be painted with carbolic acid and a blanket dipped in a carbolic solution should be suspended near the door, to aid in keeping out the flies which swarm the stable.

2. The animals should be washed with a solution of carbolic

acid (1 to 100) every evening after returning from the field. This will serve to repel the flies and lessen the effect of the Bacillus.

3. As thorough disinfection of the creeks and roadsides is impossible, animals should be kept in dry lots, every foot of which has been treated with chloride of lime.

4. Animals should receive only well water, and the well should be in a dry lot.

5. If animals break out of the lot and wander onto infected ground, they should, as soon as discovered, be treated with potassium chlorate and iron, as above prescribed. It has been ascertained that the period of incubation is from five to seven days, therefore much may be done to neutralize the poisonous germs before the disease is externally manifested. Such animals however should be placed in a pen apart from all others and every precaution taken to prevent any intermingling with sound animals.

6. All dead animals should be burned immediately where they died and the spot afterwards sprinkled with chloride of lime.

The importance of disinfection and quarantine is seen when we note that the plantations which suffered the heaviest losses this year were those that lost most in 1867, and have proved conspicuous in all the milder epidemics since. The "disease" then is still there. In the highlands, very little Charbon was found, and animals taken from the bottoms and kept in the hills did not take the disease. There was wisdom in removing the mules from localities where the disease had been previously known to exist, and transferring them to a purer atmosphere, surrounded by hygienic comforts which it would be impossible to give them at home.

The following extracts from a letter received from J. G. Poindexter, Palmetto Home, Miss., will give some idea of the value of pure surroundings. He says: "My first experience with Charbon was in 1867 in LeFlore county, Miss., where I then lived. We had about forty cases of which seventy-five per cent died.—They were treated by every method recommended by the most experienced practitioners in the valley, and I became satisfied that no one knew any thing about it, so far as treatment was concerned. The next year (1868) about the middle of May, the

best mule on the plantation was brought in with one of the worst cases I ever saw. Being assured that there was no cure for her, I ordered the men to take her back into the swamp and leave her to die. The mule on the fourth day came home well. During the summer every mule on the plantation had the disease and after spending a few days in the woods, all returned home cured. From that year (1868) until 1882, I had more or less Charbon among my stock and with the same success. In 1881 it was very bad on this (the lower) end of Silver Creek. I wrote (from North Carolina) to my manager to take all of my stock back into the swamps nine miles from the nearest settlement. One of my neighbors had lost several mules and had several sick at the time. My manager allowed him to put his stock with mine and kept them all out several weeks. The sick all recovered and there were no new cases. It again appeared in 1882. Having lost our fences by a flood, I had to keep my mules up, the result was that five out of the ten cases died."

Mr. Poindexter's success was due to his getting his mules off the infected grounds. "Nine miles from the nearest settlement" would put them where no mules had died and consequently where the soil was not infected with the germs of the disease. "The flood of '82" which was followed by hot weather was most favorable to the development of Charbon. The "five out of ten" cases might also have been saved if the proper disinfection of lot and stable had been attended to and pure water provided. I have noticed all through the Delta that farmers are very careless about the quality of water given to stock.

Dr. Williams in speaking of Charbon in Europe says:— "The influence of marshes is so great that precautions are taken in several counties by keeping the animals back from the action of the miasmatic gases and effluvia during the heat of the day; and at the commencement of the heat, the flocks and herds are driven up to the mountains and high places, bitter experience having taught the guardians of the flocks that if they do not take these precautions, nearly their entire stock of animals will be destroyed by Charbon."

INOCULATION.

Introducing the disease into the system and thus subjecting the animal to a mild attack of Charbon has been proven in Europe to "confer a complete immunity against future attacks of the disease." The following taken from the *Lancet* of October 15, 1881, will illustrate the point: "With regard to Symtomatic Anthrax or Chabert's disease, black quarter or quarter-ill, a disease due to a bacterian, differing in specific effects from that of splenic fever, experiments conducted by Arloing, Cornevn, and Thomas demonstrate in the clearest manner that the injection of the specific bacteria into the blood, care being taken to prevent their introduction into the areolar tissue, causing a slight and evanescent illness, confers a complete immunity against future attacks of the disease, but does not render the animal proof against splenic fever."

"Twenty five cattle were collected at Chaumont, thirteen of these had been inoculated with the virus of symptomatic anthrax, nine months before, the other twelve had not. All were inoculated with symptomatic anthrax in the cellular tissue. Of the twelve unprotected animals, nine are dead and two others are ill. Only one resisted the inoculation and it was found that this animal had been, during the previous year, in a stable which was visited by an outbreak of the disease. Of the thirteen protected animals, only one presented slight pyrexi, lasting a few hours; in the others the inoculation was absolutely without effect." Dr. J. W. Connoway, employee of the Station, spent seven weeks in the Delta, investigating the disease, and during that time inoculated one hundred and thirty-one mules, nine horses, and nine cattle.

Inoculation consists in giving the animal a mild form of Charbon, by injecting into the blood a small quanity of vaccine virus. The process is very simple and can be carried out by any one, willing to exercise a little care and patience. The virus is not expensive and may be obtained through the Experiment Station. The effect of the inoculation will not last more than from seven to eleven months and it would be necessary to inoculate every year. But as the disease occurs as an epidemic only after an exceptionally mild winter, inoculation would only be required during the spring succeeding such a winter.

THE NEED OF EXPERIENCED VETERINARIANS IN MISSISSIPPI.

The fact that such a disease has existed and caused such great loss of life for so many years without investigation, at once suggests the necessity for more experienced men in our state. We have already scores of "Horse Doctors" with their salt petre and turpentine, but what is needed is an experienced Veterinary Surgeon in every county and every town. I suggest two ways by which this end may be accomplished.

1. Each county might send a bright young man to one of the northern Veterinary Colleges, the county to pay the necessary expenses on condition that after graduation he should settle and practice Veterinary Surgery in that county for a term of years.

2. The State Legislature might appoint a State Veterinarian, so that in case of an epidemic, the State officer could call out, as co-workers, his own men in the persons of farmers' sons.

In other countries and even in the northern states, a knowledge of Veterinary Science is now considered an essential feature of every farmer's education. In this region, it should be doubly so, for here our farms being larger, the farmer is obliged to handle much more live-stock. Our climate also being milder, and our country lower, our animals are more likely to be affected by the germ diseases.

SUMMARY.

To sum up the practical points enumerated in this bulletin I recapitulate as follows.

Preventive Treatment: All mules and horses should be inoculated after a mild winter. Care should be taken that animals do not become overheated, and they should be protected from flies while at work or in the stable, which may be effected by bathing with the carbolic acid solution, one bucket full being sufficient for about five animals. The stable should be disinfected by sprinkling with a solution of copperas, and the stable lot sprinkled with chloride of lime. Animals should be well fed, and have pure water for drinking.

Symptoms: Usually for some hours before the diease shows itself by external swellings the affected animal will manifest signs

of general depression, such as drooping of the ears, sunken eyes, and a flagging gait. As the disease progresses the temperature may rise to 105° and swellings make their appearance in the region of the belly, breast, and throat. If not checked, these swellings will continue to enlarge until the animal dies.

Treatment: The moment the first symptoms of the disease are noticed the animal should be drenched with—

Chlorate of Potash, 4 drachms,
Tincture of Muriate of Iron, 1 table spoon full.

Give in a pint of water, and repeat in three hours. Bathe the swellings with a mixture of one part of carbolic acid to eight parts of water. If the urine is suppressed add an ounce of salt peter to the drinking water, and if the bowels are inactive give half ounce doses of linseed oil once every two hours until relieved. An abundance of good nutritious food, pure air, well water, and protection from hot sun and rain are absolutely essential to success. All animals dying from the disease should be burned at once, and the place immediately disinfected by sprinkling with chloride of lime and carbolic acid. A supply of medicines should be provided in advance, so as to be ready for immediate use at any time.

MISSISSIPPI

Agricultural Experiment Station

BULLETIN NO. 12.

COTTON LEAF WORM.

(Aletia argillacea.)

S. M. TRACY, Director.

AGRICULTURAL COLLEGE, MISS.

JUNE 25TH, 1890.

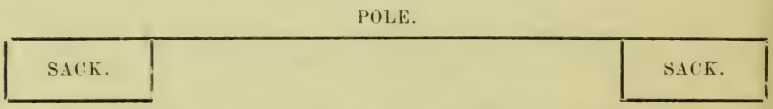
THE COTTON LEAF WORM.

(Aletia argillacea.)

During the seasons of 1888 and 1889 the Station made a number of tests in order to determine the cheapest and most effective method for destroying the cotton leaf worm, and in all cases it was found that if Paris Green was dusted over the leaves, even very lightly, the crop was fully protected.

For a small area we have found no better method than that described in Bulletin No. 2 of this Station, which is as follows:

Make two sacks of heavy cloth, each about ten inches long and four in diameter, open the whole length of one side and firmly sewed at the ends. We have found "8 oz. Osnaburg" the best cloth for the purpose. Take a strip of oak or other strong wood about one and a half by two inches, and five feet long, and bore a one inch hole five inches from each end. Tack one of the sacks to each end of the pole. fastening one of the edges of the opening to each of the narrow sides of the pole, so that the sacks will be in a position as shown in the sketch.



The sacks can be filled by pouring the poison through a funnel inserted in the holes through the pole, and distributed by riding on horseback through the cotton rows, dusting two rows at a time. A little practice will enable one to do this work very evenly, and care must be taken not to allow the sacks to touch the leaves when wet or the poison will not pass through. When the sacks are freshly filled a very slight jarring will shake out a sufficient amount of the poison, but when nearly empty the pole should be frequently and sharply struck with a short stick, or spaces in the rows will be missed. When used in this way we have found it best to use the poison without any admixture of

flour, and if flour is to be added lighter cloth should be used in making the sacks.

With a pole and sacks as described one man and mule can poison from fifteen to twenty acres per day.

Where more rapid work is desired, we have found no other machine equal to the "Roach Poison Distributor" made by J. P. Roach & Co., of Vicksburg, Miss. This machine is made like a two-wheeled sulky, with a fan attachment geared to the wheels and connected with a reservoir containing the poison. With this machine seven rows can be thoroughly dusted at once, and by changing, two teams and drivers can dust seventy-five acres per day. The machine costs about fifty dollars, the price of one bale of cotton, and is the most satisfactory machine for the work we have found.

Whether the pole and sacks, or the machine, should be used will depend on the number of acres to be dusted. After the worm makes its appearance it spreads very rapidly, and it is important that the whole plantation be gone over at once. If this can be done within two days with poles and sacks, that will be the cheaper plan, but if the worms are likely to spread faster than the field can be treated in this way then it will be better to buy a machine.

With either plan it is best to do the work in the evening or early in the morning when the leaves are wet with dew, as the poison adheres much better at that time, and often it will be found best to work all night when there is sufficient light.

It makes but little difference how much of the poison is used, *provided it is well distributed so as to cover every leaf.* If dusted over the leaves evenly, we have found half a pound to the acre to be sufficient, but as few workmen are as careful as is necessary in using so small an amount, we have found it best to use about two pounds per acre with the pole and sack plan, and one pound with the machine. In using the machine it is best to use three pounds of flour to one of the poison, as the flour assists materially in making the poison adhere to the leaves. When the pole and sacks are used the workman should be careful to keep the poison from blowing over himself more than can be avoided, and when the work is done he should shake his clothing thoroughly and take a bath. A few buckets of water

should also be poured over the mule. With these precautions we have never known either sickness or injury to follow the use of the poison.

Whatever plan may be adopted for destroying the worms it should be determined upon and prepared for in advance. A liberal supply of the poison should be purchased, and the apparatus for distributing it all ready for work, as "time is money" in dealing with cotton worms, and a delay of a day in applying the poison may make a difference of hundreds of dollars in the crop. The fields should be closely watched and work commenced on the very day when the worms make their first appearance. A single application of the poison, if not followed too soon by rain, is usually all that is necessary to fully protect the crop, and the expense of this need not be more than fifty cents per acre.

In dealing with the worms, more than in almost any other farm work, promptness and care are essential to success, and with these there need be but little fear of loss from what has been the most troublesome enemy of the cotton crop.

MISSISSIPPI

Agricultural Experiment Station,

BULLETIN NO. 13.

FEEDING FOR MILK AND BUTTER.

E. R. LLOYD, AGRICULTURIST.

AGRICULTURAL COLLEGE, MISS.

SEPTEMBER 25TH, 1890.

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The bulletins of the Station are sent free of charge, to all persons in this State who apply for them.

FEEDING FOR MILK AND BUTTER.

On November 24th, 1889, sixty cows were put into the Station barn for the purpose of making a series of tests to determine the most economical food for the production of milk and butter. The herd was divided into six lots containing ten cows each, of which seven were common "natives" purchased in the immediate neighborhood, two were low-grade Jerseys and one a grade Devon belonging to the College.

Each cow was given all the hay she would eat, and as much grain as was thought safe. The barns containing the hay which had been stored for winter feeding were destroyed by fire in September and October, and the "mixed hay" referred to was cut during the latter part of October and November in uncultivated fields. It had been touched by frost and contained a considerable amount of asters, broom-sedge, iron-weed and other almost worthless materials, though about three-fourths of it was Japan clover *(Lespedeza striata)*, with a small amount of Chicken-corn *(Sorghum vulgare)*. In estimating the expenses of the work, this hay is valued at seven dollars per ton, Bermuda hay at ten dollars, cotton seed at nine dollars, cottonseed meal at twenty dollars, and corn meal at fifty cents per bushel (twenty dollars and eighty-five cents per ton).

The test was continued twelve weeks and the general results were as follows:

	FEED.	Cost of Feed.	No. Gal'ns Milk.	Cost per Gal. Av.	No. pounds Butter.	Cost per pound. Av.
		$		cts.		cts.
1st Lot	Bermuda Hay and Cotton Seed.....	62.32	795.01	7.8	359.46	15.70
2d. Lot	Mixed Hay and Cotton Seed.....	56.86	756.90	7.5	339.46	15.62
3d Lot	Bermuda Hay and Cotton Seed Meal.....	123.78	1058.04	11.7	418.50	26.83
4th Lot	Mixed Hay and Cotton Seed Meal.....	108.99	957.01	11.5	419.98	23.62
5th Lot	Bermuda Hay and Corn Meal.....	121.62	848.28	14.3	297.66	37.31
6th Lot	Mixed Hay and Corn Meal	103.91	802.51	12.9	280.20	33.65
		577.48	5217.75	11.1	2115.26	25.46

As will be seen in the table above, the best results were from Lot 2, which was fed with mixed hay and cotton seed: this lot

giving milk at a cost of 7.5 cents per gallon, and butter at a cost of 15.62 cents per pound. Lot 1, which was also fed with cotton seed, did very nearly as well. The most expensive milk and butter were from Lot 5, which was fed with Bermuda hay and corn meal, the milk costing 14.3 cents per gallon and the butter 37.31 cents per pound. The average cost of milk for the six lots was 11.1 cents per gallon, and of butter 25.46 cents per pound.

The results show very clearly that for the winter production of both milk and butter, Lespedeza is a cheaper hay than is Bermuda, and that cotton seed is much cheaper for the grain ration than either cottonseed meal or corn meal.

Details of the work were as follows: In selecting the cows it was the aim to make each lot of ten represent, in quality and breeding, the herd of the average farmer as nearly as was possible, and the test was continued through the ordinary feeding season. The average weight of each lot at the beginning was 6968 pounds, and none of the lots varied more than 475 pounds from that weight. Care was taken that the cows in the different lots should be, as nearly as was possible, the same length of time from calving. The food for each lot was weighed separately morning and evening, and all waste reweighed in the morning; and the cows charged with the amounts actually eaten. The milk from each cow was weighed separately at each milking, and samples of the milk were taken for testing on Wednesday morning and evening of each week. In taking these samples the milk of each lot was thoroughly mixed, and one litre (about a quart) taken for the test. These samples were kept at a temperature of 65° F. until ripened, when they were churned and the total butter yield estimated from the yields of the samples. While this method of testing the quality of the milk does not show accurately the amount of butter fat which the butter may contain, it corresponds more nearly with the actual results obtained with the churn than we have found to be the case with either the Short, Lactocrite, or other more chemically accurate methods. We used this test because we wished to ascertain the amount of butter which might be made under ordinary treatment, rather than the amount of fat in the milk, a variable per cent of which is unavailable for butter when separated by the usual dairy methods. The butter test made in the seventh week of the trial va-

ried so widely from the tests made during the other eleven weeks that it is thought there must have been some error in the work,

—TABLE NO. 2.—

	Feed No. pounds eaten per week.		Value of Feed...	Milk			Pounds of milk for 1 pound butter.		Butter.	
	Grain	Hay		Number pounds	Number gallons	Cost per gallon ...	Morning	Evening	Number pounds	Cost per pound ...
LOT ONE.						cts.				
BERMUDA HAY —AND— CORN MEAL.	2	705	$ 5.78	498.4	62.30	9.27	18.3	13.7	30.80	18.76
	3	604	5.58	668.5	82.56	6.7	17.8	13.3	42.26	13.17
	4	670	5.90	654.0	81.75	7.2	17.4	13.0	41.65	14.16
	5	665	5.76	653.0	81.62	7.0	18.5	13.5	39.53	14.43
	6	683	5.83	624.5	78.06	7.5	19.1	13.9	35.34	16.22
	7	800	10.55	698.0	79.75	13.2	26.7	22.1	26.16	40.32
	8	836	10.96	625.2	78.15	14.0				
	9	807	10.87	636.0	79.50	13.8	19.7	14.4	37.28	29.15
	10	874	11.11	628.5	78.56	14.1	22.7	18.5	29.95	37.09
	11	865	11.16	635.0	79.37	14.1	19.3	16.2	35.21	31.68
	12	844	11.16	632.0	79.00	14.0	23.9	18.1	29.46	37.88
			11.01	595.5	74.43	14.7	18.5	19.9	31.50	34.92
		9376	121 62	786.4	848	28 14 3	22 5	19.1	297.66	37.31
LOT SIX. MIXED HAY —AND— CORN MEAL.						cts.				
	2	713	$ 9.15	388.6	44.75	20.4	24.9	18.1	16.56	55.25
	3	767	8.94	500.5	62.56	14.2	33.6	25.1	16.78	53.27
	4	775	9.65	578.0	72.25	13.3	25.2	18.8	25.57	55.74
	5	605	9.23	620.4	77.55	11.9	24.5	17.8	28.76	32.06
	6	613	9.41	674.5	84.18	11.1	23.3	14.9	34.73	27.09
	7	602	9.20	606.5	75.81	12.1				
	8	599	9.24	575.5	71.93	12.8	19.7	15.9	40.97	22.55
	9	710	9.69	614.5	76.81	12.6	23.3	18.9	24.24	39.98
	10	741	9.83	630.5	78.81	12.4	23.3	16.5	32.11	30.61
	11	737	9.87	6 9.5	78.68	12.5	25.2	17.8	29.07	33.95
	12	688	9.70	633.5	79.18	12.2	20.2	19.3	31.41	30.88
		7550	103.91	6421.4	802	51 12 9	24 2	18.3	280	20 33.65

—TABLE NO. 2.—

LOT ONE.
BERMUDA HAY
—AND—
COTTON SEED.

No	Feed pounds eaten per week: Hay	Grain	Value of Feed	Milk: Number pounds	Number gallons	Cost per gallon	Pounds of milk for 1 pound butter: Morning	Evening	Butter: Number pounds	Cost per pound
			$			cts				
2	705	581	5 78	498 4	62 30	9 2	17 3	13 7	30 80	18 76
3	604	635	5 78	668 5	82 56	6 7	17 8	13 3	42 36	13 17
4	670	642	5 90	654 0	81 75	7 2	17 4	13 0	41 65	14 10
5	665	615	5 76	653 0	81 62	7 0	18 5	13 5	39 20	14 45
6	685	613	5 83	615 5	76 95	7 5	19 7	13 9	35 94	16 21
7	696	608	5 87	595 0	74 37	7 8				
8	680	598	5 75	565 5	70 68	8 1	16 5	13 3	37 29	15 42
9	666	599	5 70	545 0	68 12	8 3	18 1	13 5	34 19	16 67
10	655	585	5 57	529 5	66 18	8 4	20 2	13 5	31 14	17 88
11	635	585	5 49	531 0	66 37	8 2	18 1	13 7	31 70	17 30
12	508	563	5 09	510 0	63 75	7 9	16 2	13 7	34 50	14 75
	7225	6624	12 52	6368 4	795 01	7 8	18 1	13 5	359 46	15 70

LOT TWO.
MIXED HAY
—AND—
COTTON SEED

No	Feed pounds eaten per week: Hay	Grain	Value of Feed	Milk: Number pounds	Number gallons	Cost per gallon	Pounds of milk for 1 pound butter: Morning	Evening	Butter: Number pounds	Cost per pound
			$			cts				
2	597	652	5 02	482 0	60 25	8 3	17 5	13 3	30 18	16 65
3	651	685	5 30	519 5	64 93	8 2	19 5	14 6	30 10	17 57
4	580	684	5 16	551 8	68 97	7 5	18 3	13 9	33 73	15 29
5	580	692	5 14	596 0	74 50	6 8	18 9	13 7	36 00	14 30
6	595	738	5 40	605 5	75 43	7 1	20 2	12 6	36 82	14 67
7	472	712	4 85	566 1	67 01	7 2				
8	485	700	4 84	5 8 7	64 83	7 4	16 8	13 7	33 58	14 41
9	624	674	5 21	591 0	73 87	7 0	19 3	14 4	34 62	15 04
10	604	670	5 44	569 0	71 12	7 6	17 8	14 2	35 61	15 28
11	660	694	5 45	545 0	68 12	7 9	16 8	13 7	35 36	15 31
12	594	664	5 07	545 0	67 87	7 4	17 4	14 4	33 50	15 15
	6525	7566	56 86	6055 6	756 90	7 5	18 2	13 8	329 46	15 62

LOT THREE
BERMUDA HAY
—AND—
COTTON SEED MEAL

No	Feed pounds eaten per week: Hay	Grain	Value of Feed	Milk: Number pounds	Number gallons	Cost per gallon	Pounds of milk for 1 pound butter: Morning	Evening	Butter: Number pounds	Cost per pound
			$			cts				
2	1184	560	10 23	540 5	67 56	16 1	17 9	13 6	33 52	32 9
3	1124	561	10 66	6 9 0	79 87	13 3	20 2	13 1	35 52	30 06
4	970	480	11 16	652 0	84 11	13 2	18 5	13 8	41 11	27 14
5	869	700	10 91	524 1	103 05	10 5	20 6	13 6	44 61	24 4
6	912	700	11 10	862 5	107 81	10 3	25 9	16 8	40 04	27 72
7	992	700	11 46	862 1	107 76	10 6				
8	1015	700	11 57	810 6	101 32	11 4	18 9	13 9	48 53	23 84
9	980	700	11 41	828 0	103 87	11 1	21 6	17 1	41 90	27 19
10	1010	700	11 54	847 0	105 87	10 8	22 1	14 2	46 11	25 02
11	950	675	11 02	760 0	95 00	11 6	19 7	15 9	41 04	26 85
12	900	797	12 02	817 5	102 80	11 7	18 1	16 2	46 00	26 13
	11906	7472	123 78	8459 5	1058 04	11 7	20 3	15 2	418 50	26 8

LOT FOUR.
MIXED HAY
—AND
COTTON SEED MEAL

No	Feed pounds eaten per week: Hay	Grain	Value of Feed	Milk: Number pounds	Number gallons	Cost per gallon	Pounds of milk for 1 pound butter: Morning	Evening	Butter: Number pounds	Cost per pound
			$			cts				
2	920	560	8 82	648 5	81 05	10 7	18 8	14 1	39 36	22 40
3	898	560	8 74	624 0	78 00	11 2	17 2	12 1	47 95	19 42
4	846	680	9 73	730 5	91 43	10 6	17 5	13 0	47 56	20 56
5	833	698	9 60	714 5	92 97	10 7	18 1	14 6	44 80	22 04
6	798	700	9 59	772 0	84 0	10 4	21 1	16 8	29 11	25 02
7	769	700	9 61	760 5	85 28	10 9				
8	856	700	9 93	852 5	82 45	12 0	16 5	11 3	46 80	21 18
9	891	684	9 90	882 0	85 25	11 6	19 5	13 5	46 82	24 39
10	894	690	10 03	679 5	82 45	12 1	20 2	15 4	57 22	26 04
11	876	696	10 02	718 0	89 75	11 1	19 7	15 1	37 32	26 87
12	762	970	12 97	721 5	90 10	13 7	18 9	15 6	41 14	30 06
	9843	7658	108 99	7 9 5	957 01	11 5	18 7	14 1	419 98	25 62

LOT FIVE.
BERMUDA HAY
—AND
CORN MEAL

No	Feed pounds eaten per week: Hay	Grain	Value of Feed	Milk: Number pounds	Number gallons	Cost per gallon	Pounds of milk for 1 pound butter: Morning	Evening	Butter: Number pounds	Cost per pound
			$			cts				
2	955	700	11 39	519 0	64 75	18 2	21 9	18 7	24 92	46 01
3	880	693	11 18	624 0	78 00	14 3	27 5	23 1	24 27	46 07
4	850	698	11 00	655 0	79 87	13 8	23 4	20 0	28 72	38 30
5	885	695	11 05	627 5	78 44	14 1	21 5	20 2	27 15	39 55
6	800	667	10 55	658 0	79 75	13 2	26 7	22 1	26 16	40 32
7	836	691	10 96	625 2	78 15	14 0				
8	807	695	10 87	636 0	79 50	13 8	19 7	14 4	37 28	29 15
9	850	700	11 11	628 5	78 56	14 1	22 7	18 5	29 95	37 09
10	874	694	11 16	655 0	79 37	14 1	19	16 2	5 21	31 18
11	865	698	11 16	632 0	79 00	14 0	23 9	18 1	29 46	37 88
12	844	692	11 01	595 5	74 45	14 7	18 5	19 9	51 50	54 92
	9376	7626	121 62	6786 4	848 28	14 5	22 5	19 1	297 66	37 81

LOT SIX.
MIXED HAY
—AND—
CORN MEAL

No	Feed pounds eaten per week: Hay	Grain	Value of Feed	Milk: Number pounds	Number gallons	Cost per gallon	Pounds of milk for 1 pound butter: Morning	Evening	Butter: Number pounds	Cost per pound
			$			cts				
2	713	640	9 15	358 0	44 75	20 4	24 9	18 1	16 56	55 25
3	767	601	8 94	500 5	62 56	14 2	33 6	25 1	16 78	53 27
4	775	666	9 65	578 0	72 25	13 3	25 2	17 8	25 37	37 74
5	695	685	9 23	620 4	77 55	11 9	24 5	17 8	28 76	32 06
6	613	697	9 41	674	84 18	11 1	25 3	14 9	54	17 09
7	602	680	9 20	646 5	75 84	12 1				
8	599	686	9 24	575 5	71 93	12 8	19 7	15 9	40 97	22 55
9	740	692	9 69	614 5	76 81	12 6	25 3	18 9	24 24	50 98
10	741	695	9 83	650 5	77 81	12 4	32 5	16 5	52 11	30 61
11	737	700	9 87	6 9 5	76 86	12 5	25 2	17 8	29 07	33 95
12	688	700	9 70	6 1 5	76 18	12 2	20 2	19 3	31 41	30 88
	7550	7440	105 91	6121 4	802 51	12 9	24 2	18 3	280 20	53 15

ried so widely from the tests made during the other eleven weeks that it is thought there must have been some error in the work, and in making the estimates in this bulletin the butter tests and yields for that week are omitted.

For some time previous to beginning the tests, the cows had been kept in an ordinary pasture, and each had been fed five pounds of cotton seed meal daily. The total yield of the herd for the first week of the test was 318.17 gallons of milk, containing 150.01 pounds of butter; or one pound of butter for 16.96 pounds of milk. The average yield of milk during the ten weeks of tabulated tests was 474.34 gallons per week, containing 211.53 pounds of butter; or one pound of butter for 19.73 pounds of milk. The cost of the butter made in the preliminary week was 35.4 cents per pound, while the average cost during the ten tabulated weeks was 25.46 cents per pound; a difference of 30 per cent in favor of the more liberal ration.

The first week of the test was regarded as preliminary only, and the record for that week is not included in any of the tables.

At the commencement of the test, each cow was given all the hay she would eat, which was about ten pounds daily. The cows fed on cotton seed were allowed twelve pounds daily, but it was found that few of them would eat so much, and although some of the seed were salted, and others heated, it was difficult to induce all of these cows to eat as many of the seed as was desired. Ten pounds of corn meal were allowed to each cow in lots 5 and 6, and seven pounds of cotton seed meal to each cow in lots 3 and 4. The amount of cotton seed meal was gradually increased until ten pounds were given to each cow, but without producing a corresponding increase of either milk or butter. The weekly results with each lot were as shown in Table No. 2.

An examination of this record will show a marked and unaccountable variation in the pounds of milk required to produce a pound of butter. The cows were milked by the same persons, in regular order, at the same hours daily, and all possible care was taken that the work of each day should be like that of every other day. At no time during the tests did the mercury fall as low as 32 F. Every one who has had experience in the testing

of milk for dairies has noted these daily differences, and a number of Experiment Stations have done a considerable amount of work to ascertain their causes, but with very contradictory results.

A very constant difference was observed in the butter content of the milk from the morning and the evening milkings, which was probably due to the effects of light and exercise. The milking was done between 5.30 and 7 o'clock in the morning, and between 3.30 and 5 o'clock in the evening, thus making the intervals between the milkings fifteen and nine hours. At nine o'clock each morning the cows were turned from the barn into an open lot where they had an abundant supply of water and room for exercise, and where they were allowed to remain until 2 o'clock in the afternoon, when they were placed in their stalls. Of the morning milk 18.1 pounds were required to produce a pound of butter, while of the evening milk, only 13.5 pounds were needed. In a further study of this matter two cows were used during August and September, 1890, in making a series of special tests of the effect of time of day of milkings and number of hours between milkings. During the first week they were milked at 7 A. M. and 6 P. M., during the second week at 6 A. M. and 7 P. M., and the third week at 6 A. M. and 6 P. M. All of the milking was done by the same man, and the two days following each change in hours were not included in the record.

The amounts of milk required to produce a pound of butter from the different milkings were as follows:

TIME.		POUNDS.
7 A. M.	13 hours since last milking,	23.60
6 P. M.	11 " " " "	16.71
6 A. M.	11 " " " "	24.95
7 P. M.	13 " " " "	19.52
6 A. M.	12 " " " "	24.75
6 P. M.	12 " " " "	22.05

Average for morning, ...24.46
" " evening, ...18.59
" " 13 hours, ...21.56
" " 11 " 21.14
" " 12 " 23.77
" all tests, ...22.17

Although these results show considerable irregularity, they

seem to indicate that day and night influence the amount of butter fat much more than does the number of hours between milkings.

The effects of each ingredient of the ration, tabulated without regard to the effects of the other parts of the ration, are shown in the following table:

	FEED.	Pounds Eaten.	Gallons Milk.	Cost Per Gallon	Pounds Butter.	Cost Per Pound
Lots 2, 4. 6.	Mixed Hay	25388	2516.42	10 7	1039.64	23.6
Lots 1, 3, 5.	Bermuda Hay	27506	2701.29	11 4	1075.62	26.0
Lots 5, 6	Corn Meal	15066	1650.79	13 6	577.86	35.5
Lots 3, 4	Cotton Seed Meal	15110	2015.05	11.5	838 48	25.2
Lots 1, 2	Cotton Seed	14190	1552.01	7.7	698.92	15.5

From this it is seen that milk and butter from cows which had the mixed hay cost less than that from the cows fed on Bermuda, and that for the grain part of the ration cotton seed was much cheaper than was either corn or cotton seed meal. The use of raw cotton seed for feeding milch cows is often objected to on account of the flavor which such feed is supposed to impart to the butter. In this case one third of the cows were fed with raw seed, and the milk from the whole herd was put together before being taken to the College dairy. For several seasons the uniform price of the butter from this dairy has been thirty cents per pound during the winter months. The price has been the same during the present season, the dairy was overrun with orders, and not a single complaint was received in regard to flavor or quality of the butter; though had the entire output of the dairy been from cows fed exclusively on raw cotton seed, the case might have been different. With cotton seed at anywhere near its present price ($6.67 per ton, Sept. 20, 1890), or even nine dollars, its price in 1889, it will certainly produce cheaper butter than will any other grain ration obtainable here, though we do not advise the feeding of a full ration of the raw seed when it is desired to make a fine quality of butter. The proportion of raw seed which can be fed without injury to the

quality of the butter product is a question which is still unsettled, and one which will receive our attention during the coming winter.

CONCLUSIONS.

From the work so far accomplished, it appears

I. That for the production of milk a ration composed of Lespedeza hay and cotton seed is the most economical.

II. That cotton seed is more economical than cotton seed meal, as a grain ration.

III. That Lespedeza hay is more economical than Bermuda hay.

IV. That corn meal is too expensive for use in this State.

V. That the ration which will produce milk at the least cost is also the most economical ration for butter; if no consideration be given to the quality of the latter.

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MISSISSIPPI

AGRICULTURAL EXPERIMENT STATION,

BULLETIN No. 14.

INJURIOUS INSECTS.

HOWARD EVARTS WEED, ENTOMOLOGIST.

AGRICULTURAL COLLEGE, MISS.

MARCH, 1891.

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The Bulletins of the Station are sent free of charge to all farmers in this State who apply for them.

THE SCREW WORM.

(*Compsomayia macellaria.*)

INTRODUCTION.

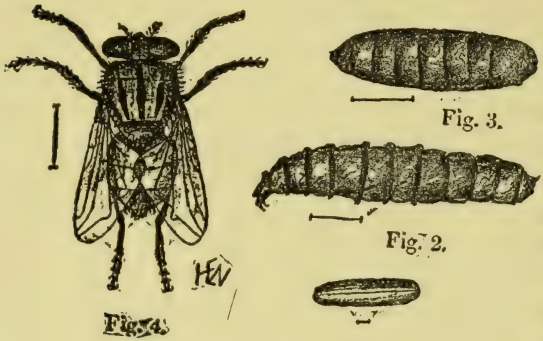
The screw worm has been known in South America for a long time, and is there much dreaded because of its attacks upon man. It was first observed in Texas in 1834, and has been present in that state almost constantly since that time. Dr. Williston, of Kansas, our authority on Diptera (flies), says the screw worm is found during the summer quite generally distributed in small numbers throughout the United States.

Its first appearance in this state was probably in 1834, the same year it appeared in Texas. For several years it caused considerable trouble, and was known as the "bung borer" because of its habit of making small holes through the skin of the animals attacked. Since 1834 it has not been known in this state in large numbers until early in June, 1890, when it appeared in the extreme southwestern portion of the state (Wilkinson county). From there its spread northward was very rapid, until, near the end of the season, it was reported in large numbers throughout the southern and central portions of the state, and occasionally from as far north as Tennessee.

A visit was made to several of the infested regions and the facts stated in this article are the results of careful examinations conducted in reference to the life history of the fly, and experiments to ascertain the effect produced by different remedies. The fly has caused great damage during the past season, partly because of its appearance in such large numbers and partly

because the first few animals attacked were lost through non-treatment. When it first appeared in a locality it caused much alarm to the stock raisers because several animals were lost before the cause of the trouble was learned.

DESCRIPTION.



THE SCREW-WORM.

Fig. 1, egg; 2, larva; 3, puparium; 4, fly, enlarged (original).

The fly, of which the screw-worm is the larva, is shown at Fig. 4. It is of a bright metallic green color and somewhat larger than the common house fly. The distinguishing characteristic is that it has three distinct longitudinal markings upon the thorax, or that portion just back of the head. These lines upon the thorax will readily enable one to tell the screw-worm fly from the common green fly, which is also sometimes seen about the wounds produced by the larvæ. Attracted by the odor of dead or decaying matter they congregate in great numbers and at once begin laying eggs. A flow of fresh blood will produce odor enough to attract the flies, and they are also seen about dead animals which have been left in the field. Here they are attracted by the odor of the dead flesh and are often seen in considerable numbers upon the grass in the immediate vicinity. They are sometimes found upon fresh or nearly fresh hides where the eggs are often deposited. The flies are often quite active at night and many cases have been noted where the newly hatched larvæ were first seen early in the morning when no eggs or larvæ were upon the wound the preceding evening.

The eggs are laid in large masses where there is even a slight wound caused by barbed wire or other bruise, and often in the natural openings of the animals. The magnified egg is shown at Fig. 1. It is quite small, being about one-twentieth of an inch in length. It is of a yellowish-white color, and the

eggs are laid in masses which can be readily seen with the naked eye. Under the microscope the eggs show a prominent ridge upon one side.

Of the number of eggs laid by each female fly, we can make only a rough estimate. Other flies of the same family have been known to contain 20,000 eggs within the female oviduct. The length of time required for the hatching of the eggs is about nine hours. Many observers say the fly is ovoviviparous—that is, the worms come direct from the fly. This, however, is an error caused by other flies being mistaken for the screw-worm fly.

The larvæ or maggot is the screw-worm, and is shown at Fig. 2. The maggots when first hatched are very minute but grow rapidly and reach maturity in five or six days. They are then nearly three-fourths of an inch in length. The term "screw-worm" is applied to this insect owing to the larvæ having several rows of sharp, short bristles at each segment of the body which are of a black color and point ventrad or toward the posterior end of the body. The head is armed with two black curved hooks. Armed with these hooks and bristles, the worms are able to dig into the flesh with considerable rapidity, and it is quite interesting to watch their movements. They produce a large excavation in the flesh of the animal affected and one excavation may contain many hundreds of the maggots. At intervals of every half hour or more all the maggots seem to let go and come to the surface of the wound. They soon disappear again into the wound and take a fresh hold deeper in the flesh. A mass of blood and foreign matter comes from the wound after the maggots have resumed their work, which attracts flies to the wound and fresh eggs are laid.

When mature the maggots fall to the ground, and burrowing just below its surface, soon assume the puparium state shown at Fig. 3. The puparium is of a dark red color and about one-third of an inch long, and the segments or rings are plainly visible. During this stage of the insect's life the maggot changes from the worm to the fly. The length of time required for this change is about eight days, after which the flies appear and, after mating, the females soon commence laying eggs.

The eggs of the screw-worm are often laid upon dead ani-

mals, which is one of the important facts proved during the past season. For many years it has been a disputed point as to whether this were true, but an examination of the carcasses of many animals which had died from various causes revealed great numbers of young screw-worm maggots, and in several cases the flies were observed laying eggs. Many of the maggots found were those of the blow fly (*Musca voritoria*) and of the common flesh fly (*Sarcophaga carnaria*), but in each case examined many maggots of the screw-worm fly also were found. Prof. Morgan of the Louisiana Experiment Station made many careful observations in regard to this during the past season which fully confirm the statements made above.

This fact, that the worms are propagated upon dead as well as upon living animals, explains their rapid increase in localities where carcasses are allowed to remain unburied. If they propagated on living animals alone, we might hope to exterminate them by the careful treatment of the animals affected. It is the common practice to leave dead animals in the field to be devoured by buzzards or dogs, and the length of time before the flesh is entirely eaten off varies from a day to two weeks. Even then the carcass is not fully devoured. The bones and head being left, and between the former and within the latter, the maggots thrive. Even granted the carcass was fully eaten, frequently the screw-worms would have time to reach maturity and go into the ground before their food supply was exhausted. Knowing this, the best manner of checking the number of worms becomes evident. If dead animals were immediately burned or buried the increase of the worms would be greatly checked. Burning is the better method, as the screw-worms reach maturity and the flies come to the surface if buried less than two feet deep, and the carcass will probably be exposed on the surface by dogs unless buried even deeper. There must be a change in the manner of disposing of dead animals if we wish to be rid of the screw-worms.

The eggs are also sometimes laid in moist and decaying vegetable matter. This fact has been known for a long time, and the observations of last year in this regard fully confirm the statement. Thus it is readily seen that care must be taken in disposing of waste vegetable matter in localities where the

screw-worm is abundant. This insect has not been common in this state since 1834 and it is supposed to be killed out by the cold of winter. The present winter having been a mild one, we may look for a large increase of the flies during the coming season. Most of the flies have probably been killed in the central portion of the state, but in the southern portions some few flies will probably survive the winter. In Louisiana many cases were met with in mid-winter, and one case was reported from Hinds county late in December. This being the case, the flies will have an early start this season, and unless all cases are treated they will increase much more rapidly than last year. Many of the largest stock raisers of the state say that if the screw-worm is as prevalent this year as last, stock raising, as far as they are concerned, will be at an end. Not because the cases cannot be treated, but because it takes such constant care and attention that the stock cannot be raised with profit.

ANIMALS ATTACKED.

MAN.—The screw-worm becomes an alarming danger when we consider its attack upon man. In South America, as already stated, it causes much suffering. It is to be remembered that this fly is often active at night as well as in the day, hence one can readily see the necessity of mosquito bars being used even when the mosquitoes are not numerous. Several well authenticated cases were reported of its attack upon man during the past season, the eggs generally being laid in the nostrils and often causing the death of the person attacked.

CATTLE.—Next to man its attack upon cattle is of the most importance. Cattle are attacked more than any other animals, and in localities where the screw-worm is abundant, should be examined every day. The eggs are deposited wherever a wound is made by a hook from another animal, injury by a barbed wire, or other cause. Many cases are met with where ticks (*Ixodes bovis*) have been abundant. When a tick is crushed, leaving a drop of blood on the skin, the fly may deposit a mass of eggs, and within a few days the larvæ hatching from the eggs will cause a bad wound. The favorite place of attack when ticks have been present is just behind the udder, and in over half the cases noticed last season this was the seat of

attack. One case was observed where the tail had been attacked and eaten off. Cows in which there is a retention of the afterbirth are quite apt to be attacked about the vulva, and when cattle are tagged during the season in which the screw-worm is prevalent, they are liable to attack on the ear where the tag has been placed.

HORSES AND MULES are quite often attacked. Here the attack is made at the sheath, flank or legs—in fact, anywhere the skin has been injured.

SHEEP are attacked when injured by dogs, or, when the sheep are in poor condition the eggs are laid upon the wool, and when the larvæ hatch they immediately bore into the skin. In many cases the sheep are attacked within the nasal cavities and the worms eat into the head.

HOGS are quite often attacked when injured by barbed wire or other cause. A favorite seat of attack in hogs is upon the ear.

DOGS are comparatively free from attack, but several cases have been noticed.

SYMPTOMS OF ATTACK.

In general, the first thing noticed when an animal is attacked will be a flow of blood from the wound made by the maggots. The blood will serve to attract more flies and fresh eggs will be laid. Thus additional maggots are soon hatched and the wound becomes larger. When a large wound has been made the edges will be composed largely of dead flesh, which not only attracts more screw-worm flies, but many other flies as well. When sheep are attacked and become emaciated blow flies will lay their eggs upon the wool and the animals soon become a mass of maggots. In such a case the best treatment will be to burn the carcass at once. The animals, when attacked, soon begin to lose flesh, become emaciated, and, unless treated, die of blood poisoning in the course of a few days.

TREATMENT.

Nearly one-half the cases in cattle occur where ticks have been crushed. The great trouble is that the cattle are not kept free from these pests. The old manner of killing the ticks by the application of kerosene, chloroform, sulphur or tobacco,

requires more time than the average stock raiser can give, and when the ticks are destroyed in this way it is but a short time before they are again abundant. The method of combating the ticks practiced by this Station is by feeding sulphur with the salt. A covered trough is made in one corner of the pasture and in this is kept a quantity of sulphur and salt, about half and half. When the supply is nearly exhausted the trough is refilled and thus the cattle can get it whenever they may wish. Some claim this will cause rheumatism during wet weather but no such results have ever been noticed, and when thus given the sulphur will keep the cattle free from ticks.

In order to prevent injury from screw-worms in localities in which they are prevalent, all animals should be looked over every day to see if they are in anyway bruised. If a wound or bruise is found the part should be painted over with pine tar which will also assist the healing process. If the wound is a large one it should be again painted over the following day or as soon as the tar is dry. This will form an artificial scab over the wound, and as long as the smell of the tar lasts, the eggs will not be deposited. If the wound is located where a cloth can be bound over it, so much the better. Put tar upon the cloth and bind it over the wound, and keep the cloth in this condition until the wound has healed over. Fish oil and grease may be used to smear over the wound to prevent the eggs from being laid. Castor oil is a good preventive, especially for a fresh wound on which the tar cannot be used.

The great number of different remedies which have become popular in different localities show that success with any remedy does not depend upon the remedy alone, but by the care in its application. In the application of any remedy we should look (1) to the destruction of the maggots, and (2) the effect the application may have upon the wound. Some substances may act as irritants and thus only cause the wound to become larger. Some of the agents used contain mercury, and in the application of these care should be taken that the wound is not within reach of the animal's tongue, for if the mercury is taken into the system it is apt to cause death by mercurialism. Before the application of any remedy the wound should be washed out to get rid of all foreign matter and blood which

may have accumulated, in order that the remedy used may act more quickly and thoroughly.

In the application of the remedies it will sometimes be found best to throw the animal in order that the substance used may be poured into the wound and thus act more thoroughly. Sometimes the remedy can be applied to the wound in the early stage by means of a syringe. After the application the wound should be washed out to prevent any irritating effects, and then coated with tar to prevent the laying of fresh eggs. The more important methods of treatment are given below:

CRESYLIC OINTMENT is a preparation which is used in Texas with much success. It has the desired effect upon the maggots and contains enough carbolic acid to prevent fresh eggs from being deposited.

COAL OIL acts as an irritant when applied to the surface of a fresh wound. It causes the maggots to let go, and when used the wound should be washed out at once to destroy the irritant effects of the oil.

SPIRITS OF TURPENTINE has about the same action as the above and when used it will assist the wound in healing.

ETHER stupefies the maggots and will cause them to let go. The wound should be washed out after its application.

CHLOROFORM is one of the best remedies for the screw-worm. If the chloroform remains in the wound but a short time it will only stupify the maggots and not kill them. It will cause them to let go however and they may be washed out afterwards. But if the chloroform remains in the wound some time (say five minutes) it will kill the maggots. If chloroform is used the animal should be thrown in order that it may remain in the wound for some time. If it is applied with a syringe the maggots should be taken from the wound by a pair of forceps, the wound washed out, and tar or castor oil applied.

CORROSIVE SUBLIMATE is a very powerful agent and should be used with care. In a diluted state it is an excellent remedy as it also has a healing effect upon the wound. It should be diluted to about sixty grains to the pint of water.

CARBOLIC ACID is of two kinds, the crystalized and the crude,

the former being much purer than the latter. If the crystalized acid is used it should be diluted with water. The crude acid makes a very excellent remedy in case of large wounds or old cases. When applied it will kill the maggots and have a healing effect upon the wound by causing the dead and decaying matter to slough off.

CALOMEL is much used and with success by working thoroughly into the wound. If used alone in large quantities it will over stimulate the wound which will prevent it from healing. If within reach of the animal's tongue it is apt to be licked off and cause mercurialism. It is an excellent agent to dust over the wound after it has been treated with chloroform.

PYRETHRUM is highly recommended by Dr. Riley, it being "useful in destroying the worms and particularly in causing them to leave the affected parts."

CONCLUSION.

To sum up the principal items in regard to the screw-worm we have,

1. The screw-worm is hatched from eggs laid by a fly resembling the house fly, but distinguished from it by being of a metallic green color, and having three longitudinal dark markings upon the thorax.

2. The eggs may be laid upon any animals wherever there is an abrasion of the skin, or in the natural openings.

3. The young worms eat into the animal tissue, more eggs are deposited and the wound becomes larger.

4. Upon reaching maturity the screw-worms drop to the ground, assume the puparium state and, after a few days, come forth as flies.

5. All animals should be carefully examined every day in localities where the screw-worm is abundant.

6. If the animals attacked are left untreated, they soon loose flesh, become emaciated, and die of blood poisoning in a few days.

7. As the eggs are also laid upon dead flesh and decaying vegetable matter, all dead animals and decaying vegetable matter should be burned or buried.

8. The screw-worm is killed by a cold winter, but the

past winter having been a mild one, we expect a large increase of the flies this season.

9. Cases of the screw-worm can be very easily treated, but require constant attention.

10. The best remedy to be used will depend upon the condition of the wound. Preference is given to chloroform in a fresh case and crude carbolic acid in older cases.

PEA WEEVIL. BEAN WEEVIL.

(Bruchus pisi.) *(Bruchus obsoletus.)*

These two weevils resemble each other very much, both in appearance and habits. The pea weevil is shown at *a* in Fig. 5. It is of a dark brown color and about one-fourth of an inch long. As shown in the engraving, it bears upon the wings several white spots, with a large prominent white spot upon the thorax, or that portion just back of the head. The wings do not cover the posterior portion of the body, and upon this exposed portion is a prominent T-shaped white spot. These white spots are due to the coloration of the fine hairs which cover the body.

Fig. 5—PEA WEEVIL. a, mature weevil; b, pea from which weevil has escaped—enlarged (original).

The bean weevil is somewhat larger than the pea weevil, and is shown at *c* in Fig. 6. It is of a dark color, the posterior exposed portion being of a reddish tinge.

Fig. 6—BEAN WEEVIL. c, mature weevil; d, bean from which weevil has escaped—enlarged (original).

The eggs of these weevils are laid upon the newly formed pods of the peas and beans. In a few days the larva hatch and eat through the young pods and into the peas or bean. Here they feed until, within a few weeks, they have reached maturity and have eaten nearly the entire inside of the peas or beans, leaving only a thin shell. The radicle or sprouting portion is sometimes eaten, thus destroying the germinating power of the seeds. Weevil-eaten seeds make a poorer stand of vines than others, although about five-sixths of the seeds germinate.

By the time the peas or beans are full grown the larva have pupated within them, and in a short time change to bee-

tles. Some come forth in the fall, but the majority remain secreted within the peas or beans until spring when the eggs for another brood are laid.

PREVENTIVES.

These insects are generally first noticed at the time of planting. They are very easily destroyed by heating the seeds to 145 degrees Fahr., or by treating with a little bisulphide of carbon. When treated by heating, the seed may be placed in bags and dipped into warm water for some time, or placed above a lamp or stove. The heating, unless too severe, will not harm the germinating power of the seed, and will kill the weevils.

The method of treatment by means of bisulphide of carbon is to place the peas or beans in a tight box or bin, and by means of a gaspipe or other tube pour a little bisulphide of carbon through it so as to reach the bottom or centre of the bin. Then remove the pipe or tube and cover the bin or box as tightly as possible. The fumes of the bisulphide will penetrate all parts of the bin and kill any weevils which may be within. Very little bisulphide is needed—an ounce will treat several bushels. Care should be taken in its use, as it is an explosive substance when mixed with air, but if kept away from heat or fire and not exposed too much to air, no danger need be apprehended. All smoking or lighting of matches should be done away with when using this substance.

Some farmers keep their seed peas and beans for two years. If kept in tight bags or boxes from which the weevils cannot escape, this is a good method as the weevils will reach maturity, come forth and die during the first year. The germinating power of the seed is not destroyed when kept in this way, and at planting the seeds will be free from living weevils.

THE STRIPED CUCUMBER BEETLE.

(Diabrotica vittata.)

This insect makes its appearance as soon as the cucumber plants are well above the surface, and eats both leaves and stem throughout the entire summer. There are several broods during the season, and the beetles are to be found upon the squash, cucumber, melon, and other vines belonging to the family *Cucurbitaceæ*.

FIG. 7. — CUCUMBER BEETLE. Enlarged. (original.)

The beetle, which is about one-fifth of an inch in length, is shown at Fig. 7. It is of a light green color with a black stripe near the center of each of the wing cases, which are also bordered on the inner edge with black, giving the beetle the appearance of having three black stripes along the back. The head and forelegs are green, the abdomen and hind legs being of a darker color.

REMEDIES.

Many remedies have been tried with more or less success in controlling this pest. These may be spoken of under the heads (1) strong odors, (2) applying poisons to the plant, (3) mechanical barriers, and (4) hand picking.

Strong odors such as produced by various kinds of manure, carbolic acid, kerosene, and bisulphide of carbon are of but little value in keeping the beetles away from the plants.

Poisoning the plants by means of arsenites, pyrethrum, slug shot, and the various other poisons seems to have but little effect upon the beetles. They are poisoned by tobacco, however, with considerable success. If tobacco dust is applied quite freely to the hills, it will be a protection to the vines, as it drives the beetles away.

There are various methods of protecting the vines by mechanical barriers. Covering each hill with a square piece of

cheese cloth, supported at one end or the center of the hill by means of a strong wire or half barrel hoop, and holding the sides of the cloth in place with dirt is an excellent method. The gauze will keep the beetles out effectually, and at the same time give light, sunshine, and ventilation to the plants. The gauze will do very well if placed over the hills without support. If support is given by means of one or two upright sticks, the gauze drawn tightly over them, and the sides of the cloth covered with dirt, it will afford a very simple protection from the beetles.

Hand picking is the oldest method of dealing with these beetles, and is the method most universally used in this state. The beetles first appear upon the elevated portions of the field, and by picking them by hand at these portions of the field, the other vines will be kept comparatively free. The vines should be gone over on the elevated places every morning, and all beetles killed by crushing, placing in kerosene, or other means.

Hand picking is a tedious task when the beetles are at all numerous, as they generally are, and for this reason preference is given to excluding the beetles by cheese cloth or other gauze. The same supports and cloth may be used for several years, which makes this method of treatment very cheap.

THE PEACH TREE BORER.

(Sannina extiosa.)

This insect is so well known to the fruit growers of the state that but a brief description of it is necessary. The moths, as show ni nFigs.8 and 9, resemble small wasps, and as they fly only in the daytime, are very often mistaken for them and this resemblance undoubtedly affords protection from insect-eating birds. The moths being mistaken for wasps, escape detection by birds and various insects which would otherwise prey upon them.

Fig. 8—Peach Tree Borer—Female
Twice natural size. (After Weed.)

The female moth is much larger than the male and the two sexes differ so widely as to often be mistaken for different species. The female is shown in Fig. 8, and when the wings are spread measures about one and one-twelth inches across the wings. The female moth is of a beautiful steel blue color with an orange colored band about the abdomen.

The male moth, shown in Fig. 9, is smaller, measuring about an inch across the wings, which are more transparent than those of the female, and are bordered with a narrow fringe of brown

The moths are found throughout the entire summer, being present almost constantly from April until September. The eggs are laid in crevices of the bark near the surface of the ground, and, upon hatching, the young larvæ bore into the tree and attack the inner bark of the trunk and roots. They reach maturity and transform to the crysalids early in the following summer. Their presence is generally indicated by

Fig. 9
Peach Tree Borer—Male.
Twice natural size. (After Weed.)

gummy exudations and saw-dust like chips at the foot of the tree. The moths come forth throughout the summer and the females lay the eggs for another brood. There is but one brood a year, although the larvæ in various stages of growth may be found at all seasons.

REMEDIES.

The most satisfactory remedy for this pest is digging out or "worming" at least once a year. Late in autumn or early spring is the best time for this operation. The dirt is carefully removed from the base of the tree and the worms taken out by means of a knife. In this way the larvæ can be destroyed quite easily.

Another method of treatment is by means of hot water or hot soap suds. A little of the dirt is scraped away from the base of the tree and the hot water poured upon the lower part of the trunk. This, although a good remedy, cannot well be applied upon a large scale.

Another is to paint the affected parts with a little kerosene by means of a small brush. Scrape the dirt from about the attacked parts, and, after applying a small amount of the kerosene with a paint brush, put the earth back in position. The earth will absorb any excess of the oil and thus the tree will not be injured. A weak application of kerosene emulsion applied in the same manner as the above is also effective.

Still another remedy used with much success is by removing the dirt from around the base of the trunk and putting wood ashes into the excavation thus formed. If the attacked parts are exposed or nearly so, the lye from the ashes will come in contact with the borer, causing its death.

It is well to place a mound of ashes or even of earth about the base of the trunk in early summer. This will prevent the eggs from being laid to a large extent, and if any are laid the larvæ can be more easily dug out in the fall by removing the mound. If ashes are used for this purpose they will give better results and act as a good fertilizer as well.

THE OX-WARBLE FLY.

(*Hypoderma bovis.*)

This is a pest which is well known to the stock raisers, the "warbles" or "wolves" being very often found upon the backs of cattle. The damage done by them is considerable, causing a decrease of value of both the beef and hide. The hides of animals affected sell for less than perfect hides, and the "licked beef," as it is called, commands a lower price than that which is unaffected. The annual loss caused by the warble on the cattle received at the Union Stock Yards at Chicago is estimated by the editors of INSECT LIFE at $3,337,565. In this state a large per cent. of the cattle are affected with the wolves, and the loss caused by them is considerable.

DESCRIPTION AND LIFE HISTORY.

The fly, of which the "wolves" are the larvæ, is shown in Fig. 10. The body is densely covered with hairs which gives the fly a downy appearance. The head is rather large, covered at places with light yellow hairs. The fly is nearly three-fourths of an inch long, and at the base of the abdomen is a ring of yellow hairs. The downy appearance of the fly and the yellow colored ring of the abdomen enable one to distinguish it readily.

FIG. 10—OX WARBLE FLY. Enlarged. (After Brauer).

The eggs are laid by the female flies along the back of the animal, on both sides of the spine, during the latter part of the summer, and young cattle are attacked much more than others. The flies are found throughout the entire summer and are especially abundant during July and August. Animals, when attacked by the fly, are frantic in their efforts to avoid it, seeming to have an instinctive dread of its attack. Many claim that the eggs are laid within the skin, supposing the piercing or stinging to be

done by the fly when the eggs are laid. The ovipositer of the female fly is shown in Fig. 11, and, as is readily seen, has no sharp instrument with which it would be possible to pierce the skin. Upon this point Mr. Bracy Clark wrote as early as 1815:

Fig. 11–Ovipositer of Female Fly.
a, from side; b, tip from below—enlarged (after Riley).

"We may also further observe that there cannot be any very painful affection, as the fly has really no instrument fitted for such a purpose, the female ovipositer being a mere tube, made of flexible materials, piece inserted in piece, exactly as in a common telescope. However it is possible on reaching the skin or cuticle of the beast, which is always highly sensitive in the hairy animals, that it might produce a degree of uneasy tickling, which added to the noise, and perhaps an instinctive fear, always impressed upon them is altogether sufficient for the extraordinary alarm we see."

Upon the hatching of the eggs, one of which is shown at *a*, in Fig. 12, the young larvæ bore through the skin, and by their growth produce the prominent swellings which indicate their presence. During the autumn months the "wolves" grow but little, but by the following February they have grown to about three-fourths of an inch in length and at this season animals attacked show many large swellings along the back. An examination of these swellings will reveal the wolves within surrounded by a mass of curd-like matter which sometimes exudes from the open mouth of the wounds when the larvæ become nearly full grown. The matured larva is shown at *b* in Fig. 12.

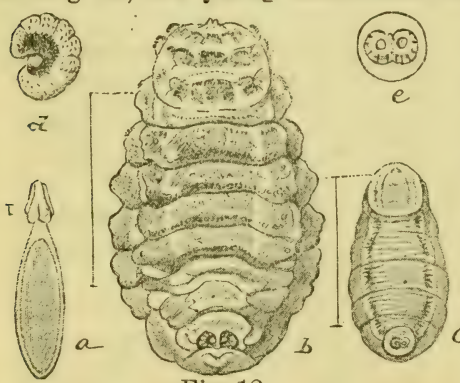


Fig. 12.
a, egg; b, full-grown larva; c, puparium; d, newly hatched larva; e, oval stigmata of larva—all enlarged (after Brauer).

Early in the summer the wolves have become full grown,

come from the wound tail foremost, drop to the ground and bury themselves just below its surface. Here the transformations are completed, the flies coming forth in about a month, and, after mating, the eggs for another brood are laid.

REMEDIES.

This insect being a well known pest, many remedies have been brought forward for its destruction. These remedies have for their object (1) the prevention of egg laying, and (2) the killing of the wolves or larvæ.

Of the first class, or preventive remedies, any substance of a greasy or oily nature is good, but as the flies are present nearly all summer the substance would have to be applied repeatedly. Fish oil or lard oil is good to use for this purpose.

Of the second class, squeezing out the wolves in the spring is the simplest, and may be easily done by pressing the swelling with the thumb and forefinger. If the opening is too small for the worms to pass through it can be slightly enlarged with the point of a knife. As every maggot produces a fly, and this fly may lay many eggs, it becomes evident that the destruction of every maggot will lessen the amount of damage in the following season. This is an easy remedy and if all the stock raisers of a neighborhood would practice it the damage would be much lessened.

As the larvæ require air for breathing, if the openings into the cells in which they live are closed, they will be killed and the wound will soon heal over. The substances mentioned above as preventives are excellent for this purpose. They should be applied to the wounds by smearing them along the back.

Miss E. A. Ormerod, consulting Entomologist of the Royal Agricultural Society, who has made a special study of this insect in England, says in regard to remedies:

"Any thick greasy matter that will choke the breathing pores of the maggot, or poison it by running down into the cell into the wound in which it lies and feeds, will answer well; and lard or rancid butter with a little sulphur has also been found to answer. Tar answers if carefully placed, so as to be absolutely on the hole into the warble."

The general nature of the wounds being the same, any of the remedies used for the screw-worm will probably be of benefit in the treatment of the warble fly. Dr. Riley recommends train oil very highly, and mercurial ointment has also been highly recommended, but its use is not advised, as it is apt to be licked by other animals, causing mercurialism.

THE PLUM CURCULIO.

(*Conotrachelus nenuphar.*)

This insect is a well-known pest to all fruit growers, the "little Turk" causing much annual loss to growers of plums, peaches, cherries and apples. It is an old enemy of the plum grower, in some localities causing a total loss of that crop. The curculio formerly did the greatest damage to plums, hence the name "plum curculio," but it feeds also upon peaches, cherries and apples. Its attack upon apples has been but recently recognized, but it bids fair to become a serious enemy to the apple.

The life history of this insect is as follows: The mature beetle shown at *c* in Fig. 13, lays its eggs upon the newly formed plums in early June. A small cut through the skin of the fruit is first made by means of jaws at the end of the proboscis or snout. Into this cut an egg is laid, which is pushed under the skin. A crescent shaped slit is now made in front of the hole containing the eggs, so as to form a flap with the eggs near the center. The object of this crescent shaped slit seems to be to produce a wilting of the fruit about the eggs by which means the larva more easily eats into the centre of the fruit.

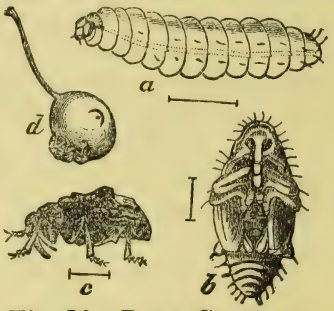


Fig. 13—Plum Curculio. a, larva; b, pupa; c, curculio; d, showing crescent cut in fruit. (After Riley.)

The egg is of a light pearl color and of an oblong-oval form. It is readily seen upon close examination of the puncture near the center of the crescent shaped cut.

In a few days the egg hatches into the footless larva shown at *a*. This resembles a maggot very much in color and form, but is readily distinguished by its rounded light brown head. It feeds upon and within the newly formed fruit, even boring into the stone. In about three weeks the larva is nearly full

grown, when the irritation produced by it working within causes the fruit to fall to the ground. Here the larva completes its growth, and, leaving the fruit which it has destroyed, enters the ground for pupation. It goes two or three inches below the surface, and, forming a smooth oval cavity, assumes the pupa stage.

The pupa is shown at *b*. Within a few weeks the transformation to the beetle is completed, and it makes its way to the surface. The beetle passes the fall and winter in secluded places and is found early the following season feeding upon the buds and leaves of plum and other trees. The beetles are found throughout the entire season, the ones which lay the eggs generally dying out by the first of August, and the newly hatched beetles making their appearance during that month. These eat into the late varieties of plums. It is this brood that are found upon apples and peaches late in the season.

The brownish-black beetle is shown at *c*. It is about one-fourth of an inch long and has a curved proboscis or snout which is bent under the body between the forelegs. The wing covers have ridges upon them, and near the middle of the back are two elevated portions, behind which are two small ochre-yellow spots. When shaken from the tree, the beetle folds its snout and legs under the body, and, being of a brownish color, is easily mistaken for a bud or small lump of earth.

FOOD HABITS.

This insect feeds upon the buds, leaves and fruit of the plum. By its attack upon cherries it causes much loss. The cherries do not, however, fall to the ground when stung by the curculio, as is the case with the plum. In this state the loss caused by its attack upon peaches is as great as upon plums, owing, no doubt, to the fact that peaches are more extensively raised.

REMEDIES.

The remedy most generally used to destroy this pest is the old method of jarring the trees. A sheet is placed beneath the tree and by means of a padded mallet the tree is given a sharp, quick blow. This causes the curculios to fall upon the sheet, from which they can be gathered and destroyed, by means of crushing, burning, or placing in kerosene oil. The

jarring should be done early in the morning or late in the evening—twilight is a good time, as the curculio is most active at night, spending the day concealed in the grass and chips at the foot of the tree. A good jarring sheet is made in the form of an inverted umbrella, placed upon a wheelbarrow, with a slit in the side opposite the handle large enough to admit the trunk of the tree. By means of such an apparatus the jarring method is very cheap.

The jarring should be begun as soon as the fruit is set, or even before. If many curculio are found at the first jarring it should be repeated the next day or within a few days. If no curculio are found, the trees need not be jarred for a few days, but if found in numbers the operation should be repeated daily as long as the little turk is found.

The mallet used in jarring should be padded at one end so as not to injure the bark of the tree. Often it will be a good plan to saw off a limb near the trunk and strike the tree a blow on the stump of the limb. If a large spike is driven into the trunk of the tree, the blow may be given upon this and thus a padded mallet will not be necessary.

POISONING WITH ARSENITES.

For many years it was supposed that this insect could not be destroyed by means of a poisonous solution similar to that used against the codling moth as described elsewhere in this bulletin. In the case of the codling moth the worm is hatched upon the outside of the newly formed fruit, and the young larva is killed by the poison as it eats into the fruit. The eggs of the curculio being laid within the fruit and the larva feeding entirely within it, the curculio cannot be reached by poison while in the larval form. But the beetles which lay the eggs that produce the larvæ, feed both upon the leaves and fruit of the tree. If, then, the trees are sprayed with Paris green or London purple at or before the time of the laying of the eggs, the beetles will be killed and the fruit will not be stung.

Experiments conducted by Dr. Clarence M. Weed at the Ohio Experiment Station throughout the past three years show that the curculio can be easily kept in check by this means. The experiments were conducted in several large orchards and resulted in the saving of nearly the entire crop. The trees

should be sprayed with Paris green or London purple in the proportion of one pound of the arsenite to 200 gallons of water. The first spraying should be done as soon as the fruit is set and repeated at intervals of five or six days. In general three or even two sprayings are all that are necessary, but if a rain follows a spraying the operation should be repeated. The spraying should not be done while the trees are in blossom, as it would kill the bees that visit the flowers. A good plan is to spray once before the blossoms are out, with two or three sprayings after the blossoms have fallen. By spraying just before the blossoms are out, the curculio which are then feeding upon the leaves and buds will be destroyed before any of the plums have been stung.

This plan has proved successful upon a large scale, but where only a few trees of a neighborhood are to be treated the jarring method is recommended. The curculio attack cannot be prevented by spraying where a few trees are treated, as success with this remedy lies in killing all the curculio in an orchard or neighborhood, as the weevils would go from nonsprayed trees to those which had been sprayed, and thus no beneficial results would be noticed.

Experiments conducted at the Michigan Experiment Station by Prof. A. J. Cook seem to indicate that jarring "is the surest, cheapest, and best method to banish the curculio." Prof. Cook's experiments with spraying however were conducted on a small scale by treating but a few trees in an orchard, leaving the larger number of trees untreated. The experiments were unsuccessful for the reason, as already explained, that the curculio could easily go from the nonsprayed to the sprayed trees. Success with spraying for the curculio lies in treating all the trees of an orchard, or better still, a whole neighborhood.

Spraying with arsenites is successful on the plum or cherry trees, and the question naturally arises as to whether it would be equally successful on the peach. There is danger of injury to the foliage if a Paris green or London purple mixture is applied in too strong a proportion. Some trees show this injury more than others. For plum, cherry, and apple trees, one pound of the arsenite to 200 gallons of water is about the right

proportion. But the peach foliage is much more susceptible to injury than other trees, and for this reason a weaker mixture should be used. As London purple causes more injury to the foliage than Paris green, only the latter should be used in spraying peach trees. The proportion which should be used is about one pound to 300 gallons of water. The leaves of the peach are not so susceptible to injury while young and in a waxy condition, as when the leaves are more mature. In applying the poison care should be taken not to have it lodge upon any portion of the tree more than others, or in other words to have the poison evenly distributed.

In just what proportion the mixture should be applied to the peach, and when best to apply, are questions which have not as yet been definitely settled. This will be one of the lines of investigation at this Station the coming season.

THE CODLING MOTH.

(Carpocapsa pomonella.)

The Codling moth or apple worm is perhaps the most serious pest with which the fruit grower has to contend. A careful estimate of the loss caused by this insect in Illinois alone amounts to four and three-quarters millions of dollars ($4,750,000) per annum. In this state the loss is probably as great in proportion to the apples grown. The codling moth is of foreign origin, having been introduced into this country early in the present century, and is now quite generally distributed throughout the United States. Although the loss caused by this insect is very great, a large per cent of this loss can be prevented by spraying with Paris green or London purple, as described below.

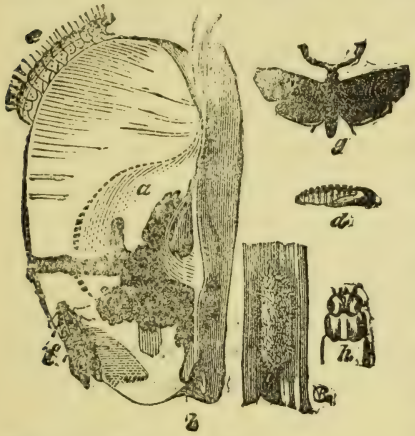


Fig. 14—Codling Moth.
a, apple showing injury; d, pupa; e, larva; f, and g, moth, (after Riley).

The codling moth, which is shown at g in Fig. 14, is of a brownish gray color, measuring about one-half inch across its outspread wings. The forewings bear a prominent copper colored spot near the margin, which is a characteristic mark by which it is readily distinguished from other moths of a similar size and form. The moth is seldom seen, as it flies only at night and is not attracted by light, but may often be found upon the windows of cellars in which apples have been kept.

The larva is too well known to need description. It is shown at e in Fig. 14.

The eggs which produce the larvæ are laid by the mature moth in the calyx end of the newly formed apple about the

time the blossoms fall from the tree. The young larvæ hatch within a few days and bore into the core of the fruit. Here they eat in and around the core, reaching full growth in about four weeks. The larvæ working within will generally cause the apple to fall, and they then bore to the outside and seek a place in which to pupate. A suitable place having been found in the crevices of the bark, or under chips at the foot of the tree, the larvæ spin a silken covering around themselves within which they cast their larval skin becoming pupae, as shown at d. The pupation period lasts about a week during which the insect changes from a worm to a moth. This change being completed, the moths come forth and, after mating, the eggs for the second brood are laid.

The transformations of the second brood are similar to those of the first, the larvæ maturing at about the time the apples are gathered in autumn. The larvæ pupate as before, or are still within the apples when gathered. Pupation proper however does not take place until the following spring as the larvæ remain as such within their cocoons during the winter. Those which are gathered with the apples form their cocoons in the crevices of the barrels and an examination of old apple barrels will often reveal many empty pupa cases from which the moths have escaped.

REMEDIES.

Knowing the life history of an insect will enable one to tell in what stage of development it can best be destroyed. "Strike the enemy at its weakest point" is a good rule to go by in fighting insect pests as well as in war. As already stated this insect was first introduced into this country early in the present century, and ever since then various remedies have been tried with varying success. The older remedies have to a large extent been found wanting, and indeed any remedy which has been or may be brought forward in fighting this or any other insect will be found wanting unless it is practiced over large areas. It is only a united effort on the part of the fruit growers in any locality that will cause the extermination of this or any other insect.

If all the larvæ were within the apples when gathered a good remedy would be to crush the insects during the winter

while within the cocoons, or keeping the windows of the cellars in which the apples have been stored closed during the spring months to prevent the escape of the moths. But as only a small per cent of the moths can be destroyed in this manner this remedy alone is ineffectual. But when the large number of eggs laid by a single female is considered it is evident that this remedy should be practiced as well as the method given below—that of spraying.

SPRAYING WITH ARSENITES.

In reviewing the life history of the codling moth it was stated (1) the eggs are laid in the calyx end of the newly formed apple, and (2) as soon as the eggs hatch the larvæ eat into the fruit. If, then, a poison can be applied to the trees so that a small particle may land in the calyx of the apple about the time of the hatching of the larvæ, they will be killed by partaking of the poison. This is the philosophy of spraying the trees with Paris green or London purple.

This method of treatment was brought forward more than ten years ago and since then many experiments have been made to determine the best manner of applying the poison, per cent of fruit saved, and the cost and safety of treatment. These experiments, as well as the ten years experience of fruit growers have all shown the practicability of spraying. When this method was first brought forward, it was practiced by but few, but the remedy has proved so successful that faith in it has ever been on the increase until now it is practiced by nearly all the more successful fruit growers. Dr. Lintner has well said "a force pump should as uniformly be found upon every farm as a plow."

METHOD OF TREATMENT.

Paris green or London purple should be mixed with water in the proportion of one pound of the arsenite to 200 gallons of water, or four ounces arsenite to fifty gallons of water. By first mixing the arsenite with a little water to the constituency of paste it will more readily mix with a large amount of water. Then by means of a force pump thoroughly apply the mixture to the trees just after the blossoms have fallen. The trees should not be sprayed before the blossoms have fallen as the

poison would kill the bees which visit the flowers. The spraying should be done in a thorough manner, the application made upon all parts of the tree, and applied in a fine spray and with as much force as possible. When the spraying is done in this manner a small amount of the poison will land within the calyx of each ayple, and as the young worm eats toward the core it will be killed by eating a small particle of the poison. A second application should be made in about two weeks after the first, or, if it rains soon after the first application, the spraying should be repeated. At the first spraying it is well to let the spray come from above as much as possible but by the time the second application is needed the calyx end of the apple will have turned down, and the application can be more direct.

For spraying, Paris green is preferable to London purple. The latter is much cheaper but is more liable to injure the foliage. While spraying, care should be taken that a large amount of the poison is not applied to any part of the tree, as this will cause the leaves to scorch. If the mixture is kept well stirred and applied in the proper proportion the leaves will not be injured. The second application may be made in the proportion of one pound of arsenite to 250 gallons of water. No danger may be apprehended from stock feeding upon the grass under the trees, as the amount of the poison is so slight that the stock will not be injured.

BENEFIT DERIVED.

A large number of experiments have been made to determine the per cent of loss prevented by spraying. The result of these experiments all show a large per cent of benefit. As a rule, spraying will result in the saving of at least seventy-five ner cent of wormy fruit. When three applications are made the per cent of benefit will be even greater.

Spraying is the best remedy to prevent injury by the codling moth. It will protect a very large per cent of fruit from injury and if all fruit growers would practice it for a few seasons, this great enemy ot fruit culture would be practically exterminated.

INSECTICIDES.

There are many insecticides—or substances used to destroy insects—which are now in common use; some of the important of which are as follows:

PARIS GREEN is an arsenite of copper and contains about fifty-five per cent of arsenic, but the proportion is somewhat variable. This substance was first used for destroying the potato beetle, but is now used to destroy any other insects which eat foliage. It retails at about twenty-five cents per pound, but when bought in quantity may be had much cheaper. It may be applied either in liquid or dry form. When used as a liquid it should be mixed with water and applied by means of a force pump. As it is practically insoluble in water, care will be necessary in making the mixture and in keeping it well stirred while using, in order that the poison may not settle at the bottom. In mixing either Paris green or London purple it is better to add only enough water to form a thick paste, and then when the poison is thoroughly wet, add sufficient water to dilute as may be desired.

The proper proportion to be used varies with the plants to which the liquid is to be applied. For spraying apple, pear, plum, and cherry trees, one pound of Paris green to 200 gallons of water should be used, though when the foliage is young and in a waxy condition a stronger mixture can be used than upon older foliage. When used upon peach foliage the proper proportion is about one pound to 250 gallons of water for the first application and one pound to 300 gallons for a second application.

When mixed with water, Paris green is an excellent application for codling moth, curculio, fall web-worm, potato beetle, leaf rollers, and various other leaf-eating insects.

Paris green may also be used advantageously in a dry form, either alone or mixed with flour. In the dry form it is the best application for the cotton leaf worm. It is easily applied pure by being sifted through bags placed at the ends of a long

pole as described in Bulletin No. 12 of this Station, or if mixed with flour and applied when the leaves are wet with dew, the "Roach Poison Distributor" will be found a satisfactory machine.

London Purple is an arsenite of lime. Being a waste product in the manufacture of analine dyes it is very cheap, being sold at less than one-half the price of Paris green. It contains a smaller per cent of arsenic than does Paris green, but for many purposes is equally good. It is used in the same manner and for the same purposes as Paris green. Many prefer it to the latter because of its cheapness, but as it is more liable to cause injury to foliage it should not be used upon tender plants, nor upon peach trees.

Tobacco is used with much success in some cases. A decoction can be made by pouring four gallons of boiling water on one pound of leaves and straining when cold, after which it is applied by means of a pump. Tobacco is especially effective in destroying lice upon cattle and poultry.

Kerosene Emulsion.—Next to Paris green and London purple this is the most useful insecticide. Kerosene destroys any insect life with which it may come in contact, but as it will also destroy foliage when used pure, it must be diluted to make it a practical insecticide.

The method of preparing the emulsion now most in use is as follows: One quart of soft soap or one-fourth pound hard soap is mixed with two quarts of boiling water. As soon as the soap is dissolved and while still hot, one pint of kerosene oil is poured into the mixture and the whole thoroughly stirred until permanently mixed. It can then be placed in bottles and kept for use at any time. When used it can be diluted with water to any strength desired, one part of the emulsion to twelve or fifteen parts water being the usual strength, and when used in this strength the emulsion will not injure the foliage and will destroy any insects which it touches. This is an effective remedy for plant lice, bark lice, tarnished plant bug, and many other insects which suck the juices rather than eat the foliage.

White helebore is a vegetable poison which destroys insects either by being eaten or by coming in contact with the

insects. It can be used very effectively to destroy caterpillars when it can be applied directly upon them. It is used as a powder or mixed with water and applied with a force pump. One ounce of hellebore to two gallons water is the proper proportion for use when applied as a liquid.

Pyrethrum is made by powdering the leaves and flowers of the plant from which it takes its name and is often called "Buhach" or "Persian Insect Powder." The pyrethrum can be obtained at the drug stores, and in purchasing care should be taken to secure a fresh article as it soon loses its strength when exposed to air, and for this reason should be kept in closed bottles.

The pyrethrum may be used in the dry form or mixed with water in the same proportion as hellebore—one ounce pyrethrum to two gallons of water. When used in a dry form it is best applied by means of a small hand bellows.

This is a good remedy for the cabbage worm, there being no danger from its use as it kills by contact with the worms and is perfectly harmless to man. Pyrethrum is also an excellent agent to destroy house flies. If dusted about a closed room at night, the flies may be swept up and burned the next morning.

Bisulphide of Carbon. This is a volatile liquid the fumes of which are very destructive to animal life. It is an explosive substance and for this reason should be used with care. If kept away from a fire however it can be used with comparative safety.

It is used to destroy ants with much success. A hole is made in the hill by means of a round stick or crowbar and a small quantity of the bisulphide is poured into it. The hole is then filled by pressing the earth around it and as the fumes of the bisulphide penetrate the hill, the ants will be effectually destroyed.

It is also very effectually used in destroying grain weevils. If it is put into the centre of the bin by means of a tube, the fumes will soon destroy all grain insects or weevils which may be within the bin.

SPRAYING MACHINERY.

During the last decade the various methods of combating the attacks of injurious insects have been almost entirely changed by the introduction of new apparatus by which insecticides may be applied, and many improvements in this respect are being made each year. The introduction of new insecticides and improved spraying machinery has fully kept pace with the increase of our injurious insects.

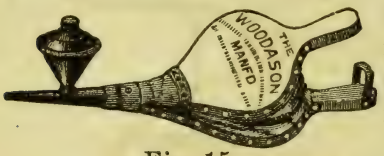


Fig. 15.

There are many force pumps now in use, some of the best of which are mentioned below. It should not be understood that those spoken of are the only ones of value, as there are many other excellent pumps, but the limits of this article will not permit of their mention. It will pay all persons interested in fruit growing to send for catalogues of the various pumps, as most of them contain much information in regard to spraying. The addresses of some of the manufacturers are as follows: Nixon Nozzle and Machine Co., Dayton, O., Field Force Pump Co., Lockport, N. Y., P. C. Lewis, Catskill, N. Y., Goulds Manufacturing Co., Seneca Falls, N. Y., Rumsey & Co., Seneca Falls, N. Y., Lansing Iron Works, Lansing, Mich., Superior Machine Co., Springfield, O., Wm. Stahl, Quincy, Ill., Thos. Woodason, 451 E. Cambria St., Philadelphia, Pa., and Albinson & Trusheim, 2026 14th St., Washington, D. C.

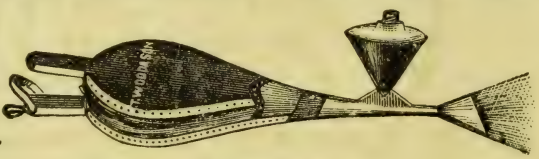


Fig. 16.

The essentials of a good pump are durability, cheapness, and the force with which it will throw a spray. It should have a discharge hose which will pump part of the mixture back into the reservoir, thus keeping the mixture stirred constantly.

If the pump is made of copper or brass it will not corrode. For spraying a few trees or a small orchard the knapsack pumps or small hand pumps are excellent, but where the

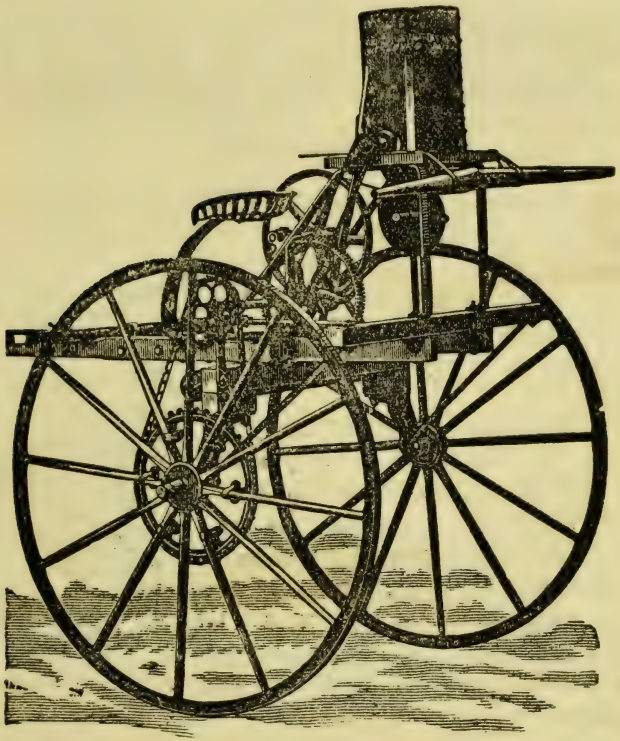


Fig. 17.

spraying is to be done on a large scale the larger field pumps will be the most economical.

To apply dry powders such as pyrethrum, a small hand bellows is very convenient. Fig. 15 represents a small bellows manufactured by Thos. Woodason, Philadelphia. It is very good for applying powder in small quantities, and sells for $1. Fig. 16 represents a larger bellows which sell for $2.

The "Roach Poison Distributor" shown in Fig. 17 is an excellent machine for applying dry powders over a large area. It is especially valuable in the treatment of the cotton leaf

worm, and is manufactured by J. P. Roach, Vicksburg, Miss.

A smaller and cheaper machine is the "Mudd Paris Green Distributor," shown in Fig. 18, which is manufactured by J. W. Mudd, Vicksburg, Miss.

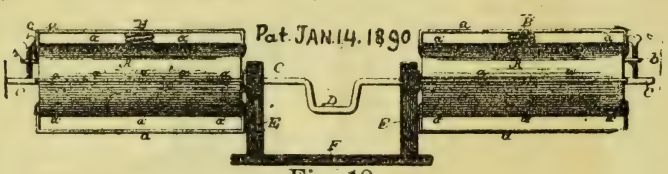


Fig. 18.

The Knapsack pump shown is Fig. 19 is an excellent machine. This is made of copper and brass and has a reservoir holding six gallons. This pump, the price of which is $14, is sold by the Field Force Pump Co. When used it is strapped to the back and is very convenient.

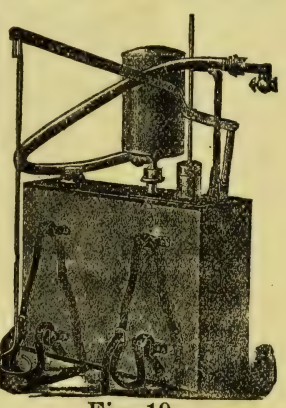


Fig. 19.

The "Galloway Sprayer," made by Albinson & Trusheim, is very similar to the above ands ells at the same price. Both these machines are furnished with the "Vermorel" nozzle.

The "Eureka," manufactured by Adam Weaber, Vineland, N. J., is a knapsack pump very similar to the above, which has been used with success at this Station and sells for $21.

Fig. 20.

A convenient sprayer for garden plants is the one shown

in Fig. 20, sold by Thos. Woodason for $2. It consists of a bellows to which is attached a tin cup for holding the liquid to be sprayed. The air passes through a tube which draws the liquid from the cup and scatters it in a fine, mist-like spray.

Fig. 21.

A good hand pump is the "Aquaject," shown in Fig. 21, which is sold by Rumsey & Co. This pump, the catalogue price of which is $9, is very useful for spraying shrubbery and small trees, and is furnished with three feet suction and three feet discharge hose.

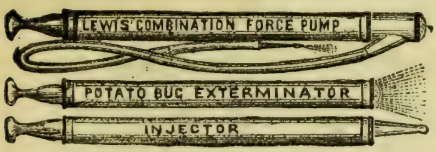


Fig. 22.

The "Lewis Combination Force Pump" is shown in Fig. 22 and is manufactured by P. C. Lewis, Catskill, N. Y. It sells for $5.50. For spraying on a small scale it is excellent.

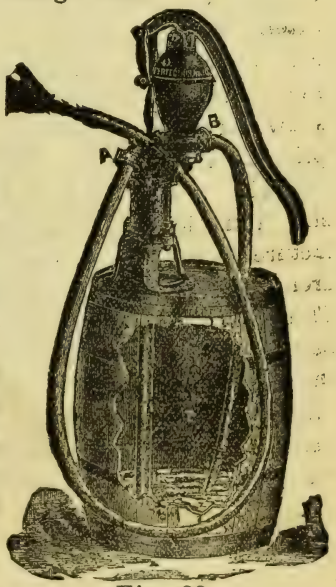


Fig. 23.

Fig. 23 shows the "Perfection" pump manufactured by the Field Force Pump Co. This may be attached to a barrel containing the poison to be used. The pump has an extra dis-

charge hose by which the poison is kept constantly stirred. The price of the pump (without barrel) is $12.

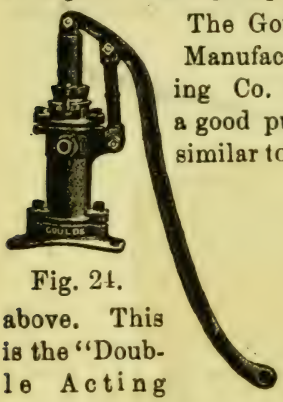


Fig. 24.

The Goulds Manufacturing Co. sell a good pump similar to the above. This is the "Double Acting Spray Pump," shown in Fig. 24. It may be fitted to either the top or side of a barrel and has two discharge hose, or it may be fitted with a gas pipe discharge for spraying several rows of low plants as shown in Fig. 25. The price of this pump is $14.

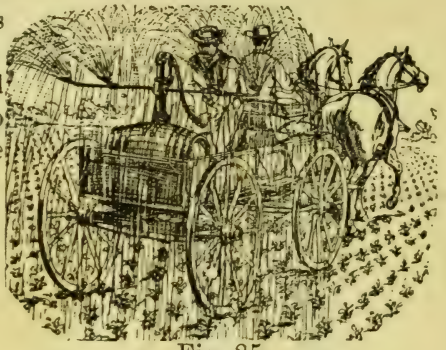


Fig. 25.

The "Maud S" pump shown in Fig. 26 is manufactured by the Lansing Iron Works, Lansing, Mich. This is an excellent pump, being furnished with a discharge pipe or agitator, which keeps the poison well stirred. This pump, with five feet hose, sells for $12.

Fig. 26.

Fig. 27 represents the "Climax Tripod" pump, which sells for $15, made

by the Nixon Machine Co. The "Little Giant," made by the same Company, is shown in Fig. 28 and sells for $35. The latter has been in use at this Station for sometime and

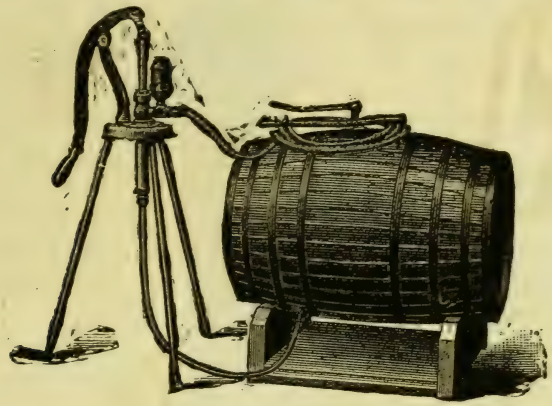


Fig. 27.

gives complete satisfaction. For use in the orchard the pump is taken off the wheels and placed in a wagon.

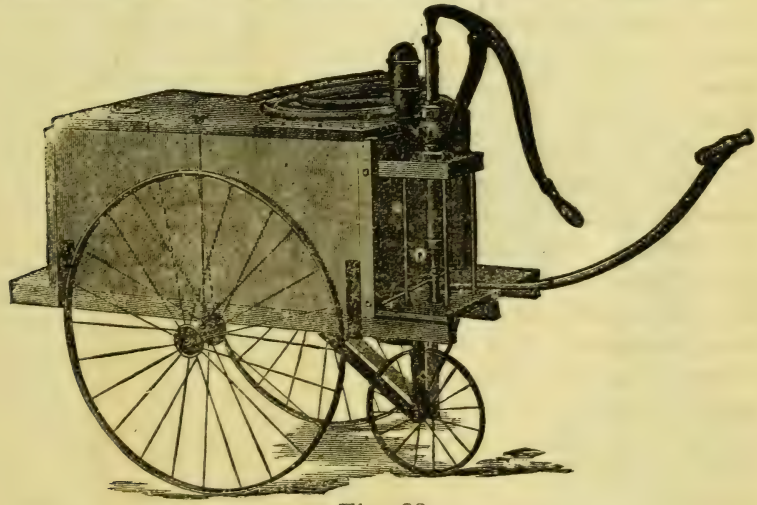


Fig. 28.

SPRAYING NOZZLES.

There are many forms of spray nozzles now in use. A good nozzle should throw either a solid stream or a mist-like

spray. It should not interfere with theforce of the stream.

The "Climax" nozzle is shown in Fig. 29 and is manufactured by the Nixon Machine Co. The advantage of this nozzle is that it will throw a stream a considerable distance. The spray is obtained by discharging the liquid through a small hole, shown in No. 2, against a wire netting shown at the upper end of No. 3.

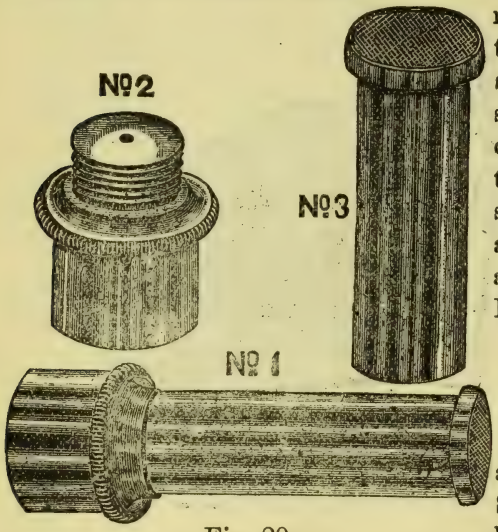


Fig. 29.

The "Boss" nozzle and the "Graduating Spray" nozzle are made by the Field Force Pump Co. The latter will throw either a solid stream or a spray of any fineness desired.

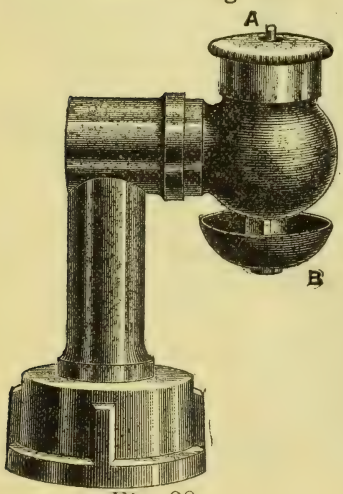


Fig. 30.

The "Vermorel" nozzle shown in Fig. 30 is probably the best general spray nozzle. This is for sale by the Field Force Pump Co. and by Albinson & Trusheim and sells for $2.

The knapsack pumps are furnished with this nozzle.

The Entomologist of the Experiment Station will be glad to receive specimens of injurious insects for identification at any time. Correspondents will receive prompt attention, and remedies will be given when practicable. Insects should be sent by mail in strong pasteboard, wood, or tin boxes to prevent crushing. When packed in cotton, jarring will be prevented, and thus the insects are not apt to be broken. Insects sent in letters are almost invariably crushed beyond identification. Any information in regard to where found, food, and damage done will aid in identification. Where worms, grubs, or caterpillars are sent, some leaves of the plant upon which they were found should be enclosed

HOWARD EVARTS WEED.

MISSISSIPPI

Agricultural and Mechanical College

Experiment Station.

BULLETIN No. 15.

FEEDING:—E. R. Lloyd.

MILK TESTING APPARATUS:—L. G. Patterson.

AGRICULTURAL COLLEGE, MISS.
JUNE, 1891.

FEEDING.

E. R. LLOYD, AGRICULTURIST.

On January 13, thirty cows from the College herd were put into the barn for the purpose of making a series of tests to determine the relative values of different foods for the production of milk and butter. The herd was divided into six lots containing five cows each, four of which were grade Jerseys and the other a grade Holstein. Care was taken in the division to have the cows in the different lots average, as nearly as possible, the same length of time from calving, and the yield of any lot did not vary more than two pounds from that of any other lot.

The test was continued five weeks, the first week being regarded as preliminary.

The general results were as follows:

	Cost of Feed.	No. Gallons of Milk.	Cost per Gallon Average	Per cent. of Butter Fat, Average	No. pounds of Butter.	Cost per pound, Average	Gain in Flesh, lbs.
1st Lot. Bermuda Hay and Cotton Seed.	$ 12.16	154.99	7.7	5.62	69.70	17.4	100
2nd Lot. Bermuda Hay and Roasted Cotton Seed.	14.55	171.79	8.5	5.55	76.30	19.1	205
3rd Lot. Bermuda Hay and Steamed Cotton Seed.	12.07	136.17	8.8	5.64	61.48	19.6	214
4th Lot, Bermuda Hay and Corn Meal.	26.42	206.32	12.8	3.86	63.72	41.4	34 Loss
5th Lot. Timothy hay and Cotton Seed	16.40	127.55	12.8	5.43	55.46	29.5	197
6th Lot. Bermuda Hay and Cotton Seed Meal.	22.34	181.68	12.3	5.38	78.37	28.5	90

The daily rations were

Lot 1,	9.2 pounds	Bermuda hay;	9.5 pounds	raw cotton seed.	
" 2,	10.5 "	" "	10,6 "	roasted cotton seed.	
" 3,	8.5 "	" "	10,4 "	steamed " "	
" 4,	9.9 "	" "	9.9 "	corn meal.	
" 5,	8.5 "	Timothy "	9.5 "	raw cotton seed.	
" 6,	10.9 "	Bermuda "	9.5 "	" " "	

The Timothy hay was "choice" from Moon, Jones & Co., Memphis, Tenn. The Bermuda was also "choice," grown by Mr. J. C. Rand of Oktibbeha county. In estimating the expenses of the work, Tim-

othy hay is valued at $20.80 per ton (actual cost and freight Dec. 12, 1890), Bermuda hay at $12.50, (selling price Dec. 1, 1890), cotton seed at $6.00, roasted cotton seed at $7.20, steamed cotton seed at $6.30, cotton seed meal at $20.00, and corn meal at $25.00 (70 cents per bushel).

The roasted cotton seed were cooked in a wire cloth cylinder six feet long and eighteen inches in diameter. This cylinder was mounted over an ordinary brick arch in which the fire was placed, and was turned by a crank. It required the labor of one man one hour to roast ten bushels of seed. The roaster was made here and cost nine dollars. The steamed seed were cooked with an "Allen Combined Feed Cooker" costing fourteen dollars. With this steamer one man could cook twenty-five bushels of seed in one hour.

The milk from each cow was weighed separately, and tests made weekly, morning and evening, from the mixed milk from each lot. In testing, both the Babcock and Beimling machines were used, and the results given are the averages of the work of the two, though the variations were seldom as much as five per cent.

The best results, so far as quantity alone is concerned, were obtained from Lot 1, which was fed on Bermuda hay and raw cotton seed. This lot produced milk at a cost of 7.7 cents per gallon, and butter at a cost of 17.4 cents per pound, but the butter was of poor quality, being sticky and of poor flavor. The most expensive milk and butter were from Lot 4, which was fed on Bermuda hay and corn meal, the milk costing 12.8 cents per gallon, and the butter 41.4 cents per pound. The butter from this lot was of excellent quality, but not so good as that from Lot 3, and cost more than twice as much. This lot showed a loss of flesh of 34 pounds also, while Lot 3 gained 214 pounds. Lot 5, fed with Timothy hay and raw cotton seed, gained well in flesh, but produced only a small amount of milk which was poor in butter fat, as will be seen by comparing Lots 1 and 5, in which the cost of the milk was 66.2 per cent, and of the butter 69.5 per cent greater from Lot 5, fed with Timothy, than from Lot 1, fed with Bermuda, the grain rations of the two lots being the same. Lot 3, fed with Bermuda hay and steamed cotton seed, gave by far the most satisfactory results in the production of butter. The amount was less than that produced by either Lots 1, 2, or 6, but its superior quality more than compensated for the deficiency in quantity, the butter being decidedly better than that from any other lot.

The Timothy hay ration for Lot 5 was too expensive to be profitable, the milk costing 12.8 cents per gallon, and the butter 29.5 cents per pound. Had the Timothy cost the same as did the Bermuda, the

cost would have been only 9.5 cents per gallon for the milk, and 21.9 cents for the butter. No difference could be noted between the quality of the butter from this lot and that from Lot 1, which cost 17.4 cents per pound. We can hardly believe that this difference in cost could have been wholly owing to individual differences in the animals of the two lots, and can only infer that the combination of Bermuda and cotton seed makes a better balanced ration than does Timothy and cotton seed.

Similar work done during the winter of 1889-90 is reported in Bulletin 13 of this Station, and so far as the two lines of work were parallel, the results agree very closely. In that work, the butter made from a ration in which corn meal was used for grain, the milk cost 13.6 cents per gallon, and butter 35.5 cents per pound, while from the lots fed with a grain ration of raw cotton seed the milk cost only 7.7 cents per gallon, and the butter 15.5 cents per pound.

CONCLUSIONS.

From the work done by the Station up to the present time it appears that

1. For the production of milk, a ration consisting of Lespedeza hay and raw cotton seed is the cheapest.

2. That for the production of butter, a ration of Lespedeza or Bermuda hay and steamed cotton seed is the most profitable.

3. That when fed with cotton seed, either raw, roasted or steamed, cows will gain in flesh better than when fed with corn meal or cotton seed meal.

4. That either Bermuda or Lespedeza hay is preferable to Timothy hay.

5. That corn meal is not an economical grain ration when fed with dry hay.

6. That steamed seed will produce better butter than will either raw or roasted seed.

HAY FOR WORKING MULES.

In order to ascertain the comparative values of Bermuda and Timothy hays for feeding to working animals, the six mules belonging to the Station were divided into two lots, one mule from each double team being placed in each lot. Both lots received the same amount of corn daily, and were given all the hay they would eat, the feeding being continued two months. The results showed that there was practically no difference between the two rations, the food for the lot fed with Timothy hay costing only thirty-six cents more than that for the Bermuda fed lot; the lot receiving Timothy hay gaining 92 pounds during the two months, while the other lot gained 90 pounds.

Comparative Tests of Machines and Methods for the Determination of Fat in Milk.

L. G. PATTERSON, CHEMIST.

For many years the dairymen of this and other states have wanted some cheap, rapid, and accurate method for determining the amount of fat in milk, so they could pay for the milk which they buy according to its quality, rather than its quantity. It is surely unfair that one man should be paid the same price per pound for milk containing six per cent of butter fat which another receives who sells milk containing but three per cent; yet this is done every day all over the country, and time and again are our dairymen decived by watered or naturally poor milks, while our farmers receive no encouragement to improve the quality of the milk or the breed of their cattle, but look continually to the feeding of their cattle for the production of as large a quantity of milk as possible, regardless of its quality.

Although there has been a very accurate method, known as the Adams Paper Coil or Gravimetric method, used in the chemical laboratories for some years, yet this method requires a delicate chemical balance and other delicate and costly chemical apparatus as well as the skill of an experienced chemist. So this method, both on account of the cost of the apparatus, and the time it takes to complete the determination, is out of the question as a dairy method, and some other must be looked to.

Mr. Short, of the Wisconsin Experiment Station, made an excellent start in this direction several years ago when he published his volumetric method, which consisted, as do all the volumetric methods, in decomposing the milk and raising the fat by the means of chemicals, and measuring the volume of the fat in the graduated neck of the bottle in which the operation is conducted. This method, although giving accurate results, takes several hours for its completion, and has, therefore, to a great extent, been superseded by better and more rapid methods.

The principal methods that have come into use since the introduction of the Short method are those of Parsons, Cochran, Patrick's Sand and Brine Bath, and Babcock's and Beimling's Centrifugal.

In the work reported in the following pages, the three methods

were used which are of the more recent introduction, and which promise to be of the most value to the practical dairyman, on account of their greater simplicity and rapidity. The Adams or gravimetric method, being the most accurate method known, was used as a check for all.

THE PATRICK BRINE BATH METHOD

was proposed by Prof. G. E. Patrick, of the Iowa Experiment Station, and is an improvement on his Sand Bath Method which was published about a year earlier. The chemicals and apparatus used in this method are:

Pure acetic acid 90 per cent..... 9 vols.
Commercial sulphuric acid, specific gravity 1.83..... 5 "
Chemically pure hydrochloric acid specific gravity 1.19..... 2 "

Saturate this with sulphate of soda; cork the bottle and place aside for use. Before using this mixture, to charge the tubes, about two per cent of methylic alcohol is added. Sulphate of soda dry and powdered is used when necessary to clarify the fat.

The apparatus used consists of

1st. The tubes, which consist of two parts. The bottom part is bottle shaped, while the upper part is drawn out into a slender neck at the lower end; the two parts being held together by a broad rubber band with a small hole in the side which is closed by the entrance of the slender neck. The slender lower portion of the upper part is of a definite size and is graduated for measuring the fat. The lower portion contains two stones, one pumice and the other some heavier stone, to aid in mixing the contents and also in cleaning the tube after the operation is finished.

2d. The Brine Bath is a zinc vessel about thirteen inches high, cylindrical, and with a rack having a gauze bottom for holding the tubes while in the vessel. The vessel is placed over a heating arrangement which will keep the brine boiling.

3d. A pipette which will deliver 14.4 c. c.

The work is carried on as follows: 14.4 c. c. of milk are measured from the pipette into the tube and allowed to run into the lower portion; the acid mixture is then allowed to run slowly down the inside of the tube until the mixture is about a quarter of an inch below the graduated tube. This is then thoroughly mixed by shaking, and filled to about half way up the graduated tube with the acid mixture. Having charged all the tubes in the same manner they are placed in a vessel of water at 140 degrees F. for ten minutes, after which they are removed to the rack and lowered into the brine bath containing enough boiling concentrated brine

to come above the level of the charge, where they are boiled for twenty-five minutes, after which they are removed and allowed to stand in the 140 degrees F. bath for ten minutes and the amount of fat in the tube is measured on the scale. If the top level of the fat comes above the small tube, it is asily lowered by raising the tube in the rubber band sufficiently to allow some of the liquid under it to run out through the hole in the side.

THE BABCOCK CENTRIFUGAL METHOD.

This method, introduced by Dr. Babcock, of the Wisconsin Experiment Station, from its rapidity, accuracy, and simplicity, is a very valuable one and deservedly stands in the front rank of the methods in use. . The chemicals and apparatus used in this method are:

1st. Commercial sulphuric acid, specific gravity 1.82.

2nd. Test bottles (Fig. 1) containing, up to the neck, from 40 c. c. to 45 c. c. with the neck graduated so that each division of the scale represents .04 c. c.

3d. A pipette (Fig. 2) for measuring the milk containing, when filled to the graduated mark, 17.6 c. c.

4th. A measure (Fig. 3) for the acid consisting of a glass cylinder graduated to measure 17.5 c. c. and having a lip for pouring.

5th. A lamp for heating water to boiling.

6th. A centrifugal machine, (See Figs. 4 and 5) of which there are two kinds in use, one running by gearing and the other by a belt, but both working on the same principle. The gear is so arranged that the wheel carrying the test bottles makes about ten revolutions to one of the crank, by which 700 to 800 revolutions per minute are obtained. Within the horizontal wheel (a fig 4) are placed sectors (b fig. 4) made of sheet copper or iron to which are soldered cups or tubes (c fig. 4) inclined at an angle of thirty degrees with the horizontal, for the support of the test bottles. The horizontal wheel is surrounded by a copper or iron jacket, with a top, to pour hot water into so as to keep the bottles warm and the fat melted.

The test is made by filling the pipette, by suction, up to the mark with the milk, and then allowing it to run into the bottles, one after another until 17.5 c. c. have been added to each one. The bottles are then slightly inclined and 17.5 c. c. of the acid is added from the acid measure. When all the bottles are charged thus, they are taken by the neck and given a whirling motion until all the curd is dissolved. They are then placed in the cups of the machine, which is run rapidly for six minutes; the bottles are filled up to the neck with hot water, replaced in the machine and whirled for three minutes. Several quarts of boiling water are then poured into the jacket, the bottles are filled about to the eight per cent mark with hot water and whirled for two minutes more. The bottles are then placed upright in the

TEST BOTTLE.

Fig. 1.

MEASURE.

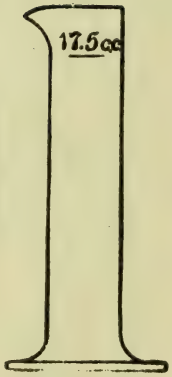


Fig. 3.

A PIPETTE.

Fig. 2.

CENTRIFUGAL MACHINE.

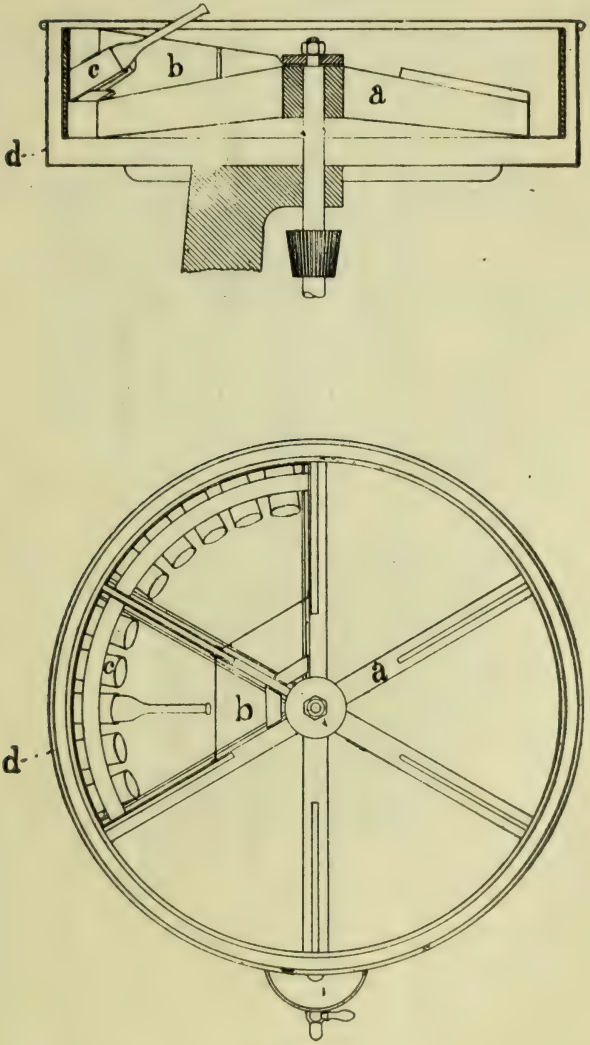


Fig. 4.

CENTRIFUGAL MACHINE.

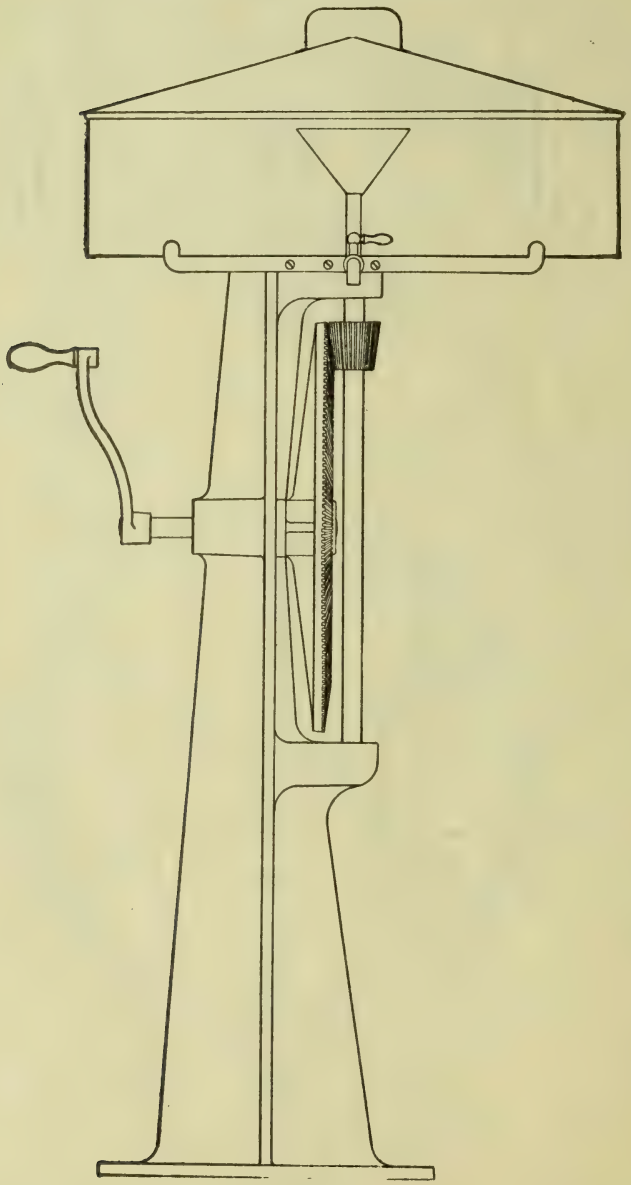


Fig. 5.

HAND CENTRIFUGAL MACHINE.

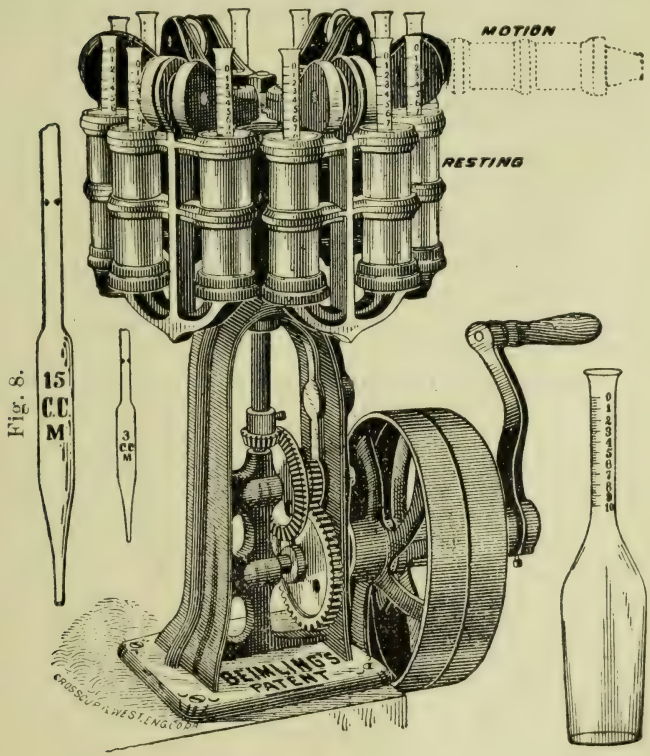


Fig. 8.

Fig. 6.

Fig. 7.

jacket so the fat may become level and the percentage of fat read off on the scale on the neck.

The Beimling centrifugal test is the only one which in our experience can compare with the Babcock in rapidity, accuracy, and the other essentials necessary for a practical milk test.

The chemicals used in this test consist of two solutions called "No. 1" and "No 2". Solution "No. 1" is a mixture of equal bulks of amyl alcohol and commercial concentrated hydrochloric acid, specific gravity 1.16. Solution "No. 2" is commercial sulphuric acid, specific gravity 1.83.

The apparatus consists of

1st. A hand centrifugal machine (Fig. 6) having a central axis to which are attached a number of pockets. The pockets are attached to the shaft by a hinge joint which allows them to hang perpendicularly when the machine is at rest but to straighten out horizontally when it is in motion.

2nd. The bottles used (Fig. 7) are of nearly the same shape as those in the Babcock, but are smaller, and the readings on the neck do not represent the percentage of fat, but a "ready reckoner" card accompanies the machine by which the degrees indicated on the neck can be read off in percentage amounts.

3rd. The pipettes (Fig. 8) are two in number, one delivering 15 and the other 3 c. c.

Method of Analysis. The 15 c. c. pipette is filled to the mark with milk, which is then allowed to run into the bottle. The 3 c. c. pipette is then filled up to the mark with solution "No. 1" and emptied into the bottle, which is then shaken so as to mix its contents thoroughly. The bottle is then filled to within half an inch of the neck with solution "No. 2" the bottle being inclined while pouring in the solution to allow it to run beneath the curd. The bottle is then shaken by hand to dissolve the curd thoroughly and filled up to the zero point with solution "No. 2". After all the bottles have been charged in the same way, they are placed in the pockets of the machine and whirled from two to three minutes. The fat will be found in the neck of the flask, read off, and the per cent found by referring to the "ready reckoner" card.

DETAILS OF WORK.

The first thing to be looked to in the analysis of milk is the sampling, which is by no means the least important part of the operation, as the cream begins to rise as soon as the milk is taken from the cow, and unless care is taken to mix the milk thoroughly just before taking the sample, results will not be accurate. The simplest way to mix milk well is to take a dipper holding about three pints, dip the milk out of the vessel and pour back several times and then take the sample at once. Also, just before taking the milk out of the containing

vessel with the pipette it should be shaken enough to have it well mixed.

The Patrick method, as will be seen by the tables, was not tested as many times as were the other two, on account of the bath beginning to leak while in the midst of the work, but a sufficient number of analyses were made to show its advantages and its disadvantages. From the beginning we were troubled by the breaking of the tubes where the graduated portion joined the upper part. This seemed to have been caused by the tubes having been insufficiently heated when the different portions were fused together. Heating the brine bath to boiling takes some time, especially where there are no means for heating it except by a lamp. The operation is somewhat long, 10+25+10 minutes for heating after tubes are charged, but by having several racks for holding the tubes, the operation can be carried on continuously with no trouble but charging the tubes, and thus many tests can be made in a couple of hours. Care must be taken to make the reading from the upper surface of the fat and not from the raised ring adhering to the sides of the tube, or the results will be too high.

One advantage of this method is that all the tubes pass through the Iowa Experiment Station and are tested before being sent out, thereby insuring accurately graduated tubes and reliable results, which cannot be said for most of the other tubes and bottles that are placed on the market by manufacturers.

The Babcock method is simple and will give but little trouble in manipulating if the directions are followed, but the acid used must have a specific gravity of 1.82 or the results will be incorrect. The most convenient way to add hot water to the solution in the bottles is to use an ordinary wash bottle or flask filled with hot water, and squirt it in when necessary. The bottles are large, well graduated, easy to handle, and the percentage of fat can be read off on the scale, which is quite an advantage.

Turning the crank at the rate of one hundred revolutions per minute for eleven minutes is not so easy as working with the Beimling, which has to be turned for three minutes only. It is rather unfortunate for the reputation of the Babcock centrifugal machine, that the one worked by a belt is allowed to go on the market, for although it gives very good results when the belt is tight, yet if it is allowed to stay on the wheel for any length of time, it stretches, and, when the machine is started, slips, does not run the horizontal wheel rapidly enough, and the results fall too low, especially if the milk contains a high percentage of fat. In the geared machine, however, there is nothing to slip, and therefore it works well. The column of fat is read from the extreme limits, and the results are excellent.

When we began our work with the Beimling machine, we were troubled to a great extent by the contents of the bottle foaming and running out of the neck when the sulphuric acid, solution No. 2, was

added, but we succeeded in overcoming that obstacle by mixing solution No. 1 thoroughly with the milk before adding No. 2, and tilting the bottle to allow the acid to run beneath the mixture in the bottle. Since that time we have not lost a single test by its foaming. The bottles are not as good as the Babcock bottles, nor is the scale as convenient to read, both on account of the fineness of the graduation and the necessity of referring to the "ready reckoner" card. The curd does not dissolve quite as readily as it does in the Babcock method, and it would be quite an addition to the apparatus to have a covered vessel with a flat bottom to heat water and place the bottles in after taking them out of the machine, for when a large number of tests are being made, the fat is apt to harden in the neck, and must be melted before being read. A convenient way to melt the fat in the neck is to squirt a little hot water from the wash bottle on the outside of it. One great advantage which this method has over all others is the rapidity with which a small number of analyses can be made, as the machine only has to run from two to three minutes, and the time taken to charge the bottles is very short. In our work, it took about thirty minutes to make twelve tests with the Beimling, including all the work, forty-three with the Babcock. To make six tests it took from twelve to fifteen minutes with the Beimling, and about twenty-five with the Babcock. After making the tests in any of these methods, the bottles should be washed immediaetly with hot water to prevent the fat from becoming hard and sticking to the sides. In reading the Beimling, measure the fat column from the bottom to the true upper surface and add one-tenth. The resutls are very accurate and compare well with the gravimetric method. Below will be found a table containing the results of the work:

Number of Analysis.	Gravimetric.	Babcock.	Beimling.	Patrick.
1	4.55	4.30	4.52	4.32
	4.51	4.40	4.52	4.32
2	4.52	4.40	4.52	4.47
	4.53	4.40	4.44	4.48
3	4.59	4.30	4.44	4.32
	4.56	4.40	4.35	4.47
4	4.67	4.70	4.80	4.64
	4.66	4.80	4.80	4.80
5	4.45	4.60	4.45	4.48
	4.47	4.60	4.54	4.48
6	4.38	4.30	4.27	4.44
	4.46	4.40	4.36	4.44
7	4.88	4.60	4.79	4.80
	4.86	4.70	4.87	4.96
8	4.96	4.80	4.96	4.96
	4.99	4.90	4.96	5.12
9	4.77	4.80	4.96	4.88
	4.93	4.90	5.05	4.96
10	5.42	4.35*	5.31	
11	5.77	4.95*	5.74	
12	4.01	2.35*	4.04	
13	6.21	5.05*	6.09	
14	5.37	3.90*	5.31	
15	5.27	5.20	5.23	
16	5.34	5.15	5.31	
17	5.32	5.32	5.40	
18	3.88	3.50	3.66	
19	4.80	4.80	4.96	
20	4.35	4.20	4.15	
21	4.88	4.55	4.74	
22	5.40	5.20	5.23	
23	3.94	3.70	3.70	
24	4.81	4.70	4.87	
25	4.22	4.00	4.10	

* The belt of the Babcock machine became loose from not having been removed for several days, and the fat percentage ran very low.

SUMMARY.

The Beimling method requires less time than does either of the others, but the scale on the bottles is not as easy to read, and no means are provided for keeping the fat in a melted condition.

The Babcock has the best bottles, but requires more time for its operation, and it is absolutely necessary to have the specific gravity of the acid exactly 1.82.

The Patrick method is very convenient where a large number of tests are to be made, but it requires considerable time to heat the bath, and the bottles are very easily broken.

By referring to the above table it will be seen that all of the methods give fairly accurate results, but in the majority of the cases the methods of Beimling and Patrick tallied more nearly with the gravimetric, while the Babcock fell slightly low, but not enough so to injure the value or accuracy of the method for practical work.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 16.

GLANDERS.

TAIT BUTLER.

AGRICULTURAL COLLEGE, MISS.

SEPTEMBER, 1891.

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The bulletins of the Station are sent free of charge, to all farmers in this State who apply for them.

GLANDERS.

The existence of glanders in many parts of the State, the absence of any law under which it can be effectually dealt with, and the general lack of knowledge among the masses as to its true character is the reason for the following brief description of the disease and the best methods of controlling it.

HISTORY: Glanders has been known to those familiar with the diseases of the horse since as early as the fourth century. Originally it was probably confined to a limited area which gave rise to the erroneous belief that a temperate climate was necessary for its propagation. Recently, however, the increased traffic in horses has spread the disease over nearly the whole globe and its cosmopolitan nature has become fully recognized. There is, perhaps, no climate too cold, nor too warm, for its propagation if the "contagion" is present.

NATURE: Glanders produces its morbid effects chiefly in the lymphatic glands, lungs, and mucous membrane of the nasal passages. These organs and tissues are more frequently affected in the beginning of the disease, but as it advances no part of the body can be said to be exempt from its effects.

CAUSES.

The causes of glanders are recognized as predisposing and exciting. A predisposing cause is merely any influence which renders the subject more susceptible to the disease-producing agency. Anything which lowers the vitality, or in other words the resisting power of the system, may act in this way. Among these influences of a depleting nature are sudden changes of

weather, bad drainage and ventilation, impure and insufficient quantities of food and water, and all debilitating diseases, especially those affecting the air passages or respiratory organs, such as distemper, catarrh, bronchitis and pneumonia.

There is but one exciting cause and that is the specific micro-organism, or "germ" of glanders. It is called the *bacillus mallei* and was discovered by Loeffler in 1882. Up to within the last fifteen years most veterinarians were willing to accept the theory of the spontaneous generation of glanders. It was thought that chronic catarrh, or any other disease of the air passages would, if allowed to run its course, sometimes develop into a case of glanders. This is now known to be a mistake. While we do not know the origin of organized life, we do know, to-day, that it is not of spontaneous generation and consequently, since we know that glanders is always due to the action of a living micro-organism on the tissues of the animal affected, we are certain that the disease never occurs except as a result of contact with the virus, or contagium of glanders.

TRANSMISSION.

Glanders occurs naturally in the horse but may be transmitted by inoculation to man, sheep, goats, dogs, and cats. It is not dangerous to man, however, except when introduced into the system through some broken surface of the skin or mucous membranes. In fact, glanders virus may be handled with impunity if there are no sores on the hands and they be washed immediately after in a five per cent. solution of carbolic acid.

The "germ" of glanders is found principally in the nodules and ulcers and in the lymphatics surrounding them. The chief source of danger is, therefore, from the discharge resulting from the ulcers and the breaking down of the nodules. This discharge is most profuse from the nostrils and hence it is this nasal discharge that is chiefly responsible for the spreading of the disease.

Greatly exaggerated ideas are prevalent as to the ease with which the disease may be transmitted from one horse to another.

The "contagium" is not carried far, if at all, in the air and therefore it is necessary that a horse come in direct contact with the discharges. Of course, if the discharge becomes thoroughly dried and powdered it may be carried some distance by the wind in the form of dust, but since thorough drying rapidly kills the germ the danger from this source is very small. In fact, an animal affected with glanders has been known to occupy a stable for a long time in which were also healthy animals, without spreading the disease. Again, a diseased and a healthy animal might be driven together for months and yet the healthy animal remain unaffected. But this however, should not blind us to the true importance and danger of the disease. Its incurable and insidious nature, and the impossibility in many cases, of making an early positive diagnosis make it one of the greatest scourges to the equine race and a source of immense loss to horse owners.

The source of infection is damp stables, feed boxes, and watering places. It is there that the "germ" retains its vitality longest, and it is also there that horses are most likely to come in contact with the nasal discharge. Hitching posts, water pails, bridles, etc., are also means by which the disease is communicated from one animal to another.

The active "germ" entering the air passages, the broken skin, or perhaps the digestive tract, is the mode in which the disease is usually transmitted. In short, it is doubtful if the disease can be produced in the horse except through the air passages, or an abrasion of the skin and mucous surfaces.

SYMPTOMS.

Many authorities describe three forms of glanders: Nasal, Farcy, and Pulmonary Glanders. This is not a strictly scientific division but for practical purposes it is perhaps the best.

Nasal Glanders: This is the most common form of the disease. The mucous membrane of the nasal cavities is chiefly affected and a nasal discharge is the most prominent symptom. This nasal discharge is, however, of but little value in making a

diagnosis, as a discharge scarcely dissimilar is common to a number of other diseases. At first it is thin and watery but gradually increases in consistency until it becomes thick and gluey. It may be greenish-yellow, bluish-gray, or streaked with blood. The quantity of the discharge depends largely upon the extent of ulcerated, or inflamed mucous surface; but it is usually not so profuse, especially in chronic cases, as in distemper, acute catarrh, or nasal gleet. In glanders the discharge adheres more to the nasal openings owing to its peculiar sticky character. It is usually odorless but may emit a strong disagreeable stench. It comes more frequently from the left than the right nostril but there is usually more or less from both. Sometimes there is bleeding from the nose. The bleeding is not profuse, as a rule, and occurs at irregular intervals.

Nodules and ulcers on the mucous membrane of the nose are of much value in aiding a diagnosis of glanders. At firs they appear high up on the septum, or partition between the nasal cavities and, therefore, are usually present before they can be seen. As the disease advances they nearly always appear on the visible mucous membrane. These nodular elevations are at first gray and hard and vary in size from that of a millet seed to three or four times that size. In a short time they become yellow and soft and finally break open. Upon breaking they discharge an acrid viscid liquid having the color and consistency of raw linseed oil. Around the edges of these ulcers, formed by the breaking open of the nodules, appear other nodules which, when they rupture, aid in forming the characteristic "pit-like ragged-edged ulcer" of glanders. These ulcers may heal and leave only a white scar to mark their former existence but that is by no means proof that the disease is cured. The ulcers are likely to again appear on the slightest provocation, such as some trivial ailment or bad care. In estimating the value of these ulcers from a diagnostic standpoint it is important to remember that ulcers may occur upon the mucous membrane of the nose as a result of direct injury, acute catarrh, or nasal gleet; but in those cases they have not the characteristic appearance af the glanders ulcers as described above.

Another very constant symptom of glanders is an enlargement of the submaxillary glands. These glands lie below the base of the tongue just anterior to the throat and on the inner side of the branches of the lower jaw. In health they are small but can be felt through the skin. In glanders they swell and may become as large as a walnut. They are at first soft and loose in the surrounding tissue but gradually become hard and finally firmly fixed high up on the inner surface of the branches of the jaw bone. If the discharge is from one nostril the gland on that side only may be enlarged, but if the discharge is from both nostrils both glands will be found more or less enlarged. These swollen glands do not as a rule suppurate and form ulcers. Moreover, they are distinctly limited and, therefore, should not be confounded with the swelling of the glands and surrounding tissues as seen in distemper. However, these glands also become enlarged as a result of chronic catarrh and therefore a mere enlargement of them is not alone sufficient proof of glanders. In chronic catarrh the glands are apt to remain loose in the surrounding tissue and are apparantly not so high up on the inner surface of the bone.

Certain other general symptoms are also commonly present. The temperature of the body usually ranges from 101 to 103° F., or from one and one-half to three and one-half degrees higher than normal. The pulse is usually somewhat faster and weaker, ranging from forty-five to sixty-five beats per minute, or from five to twenty-five beats faster than normal. There may also be a soft dull cough and slightly increased breathing.

In addition to the foregoing symptoms one or both of the other forms of the disease may also be present. That is, the lungs may become diseased, and nodules may appear on the inner sides of the legs over the course of the lymphatic vessels. These nodules are enlarged glands similar in condition to those under the lower jaw, but these frequently break and form ulcers which, however, may heal slowly. One or both legs may also "stock," or swell, and in some cases severe and unaccountable lameness suddenly developes.

FARCY GLANDERS: In this form the lymphatic system is the chief seat of the disease. The lymphatics are exceedingly delicate vessels found in nearly every part of the body. They are arranged into a superficial and deep set and are about as numerous as the blood vessels. These lymphatic vessels are supplied with valves which give them a knotted appearance. Along their course are small solid glandular bodies known as the lymphatic glands. These glands vary in size from that of a hemp seed to an almond and are very numerous just under the skin in the neck, especially along the course of the jugular vein; on the external part of the head; and along the inner surfaces of the legs. Their function is to absorb certain materials from the tissues and empty them into the blood.

As above stated the lymphatics are the chief seat of the disease in farcy glanders and therefore the most marked effect of the disease is apt to be where these glands are most numerous, on the face, neck, or legs, the last apparently being the favorite location. The first symptom may be a general swelling of the legs and the appearance of small hard nodules on the inner surfaces; or these hard nodules may appear without much general swelling. These nodular enlargements are the result of inflammation and swelling of the lymphatic vessels and glands. They are at first hard, hot and painful; but finally become soft in the center, break open, and discharge a viscid oily liquid which may at times be streaked with blood. The ulcers thus formed may in time begin to heal and then the discharge will be more of the nature of pus and resemble more closely the nasal discharges. These ulcers formed by the breaking down of the nodules, as a rule, show but little tendency to heal but if they do finally heal there is usually left a hard thick scar which may again swell, open, and form another ulcer. The formation of nodules and ulcers will follow the same general course no matter what part of the body the disease may attack. The same general symptoms are present in farcy glanders as in the nasal form of the disease and, in fact, nasal glanders may also be present.

PULMONARY GLANDERS: This form of the disease is rare and perhaps never occurs as the primary manifestation of glan-

ders. Its chief importance is from the fact that an early and positive diagnosis is almost impossible and that it is consequently one of the most effectual means of spreading the disease. In most of the so-called cured cases of glanders this pulmonary form of the disease still remains and therefore these cases are the most dangerous.

Pulmonary glanders occurs in connection with either of the other two forms but is seldom seen as a separate disease. When it does occur it is not likely to attract any attention for some time, but on that account is all the more dangerous as a means of spreading the infection. At first only a dull soft cough may be noticed but as the disease advances the animal becomes languid, loses flesh, and sweats freely on the slightest exertion. The pulse, temperature, and respirations become affected and while the animal may show no well marked signs of disease it finally dies of exhaustion. In cases presenting these general symptoms it is always well to inquire carefully into the history of the case. If the animal has had a chronic discharge from the nostrils, which finally disappeared, a careful examination of the mucons membrane of the nose should be made with a view of determining the presence or absence of scars resulting from the healing of the ulcers of nasal glanders. In this way an otherwise obscure case may be made perfectly plain. An examination of the lungs before death is not of much value in reaching a correct diagnosis. Disease may be detected but it is impossible to differentiate between pulmonary glanders and some other forms of lung disease. We have described three forms of glanders but they are by no means always so distinctly separated, nor are these three forms of equal prevalence. Nasal glanders is very frequently, farcy glanders occasionally, and pulmonary glanders rarely, seen.

All the symptoms we have described as belonging to any one form of the disease are certainly not seen in every case. All the symptoms of the whole three forms may be present in one case while in another not more than one prominent symptom may be seen. Moreover, no one symptom, no matter how characteristic it may appear, can be relied upon as positively indicating glan-

ders. It is only after carefully considering all the symptoms and obtaining a complete history of the case that a conclusion can be reached and then in many instances it must be more or less doubtful.

In the foregoing we have described the peculiar symptoms of chronic glanders which is very slow in its progress and may not terminate fatally for years. In fact, for months the disease may be so slight as not to attract attention, but all this time the animal is capable of transmitting the most severe type of the disease to other horses. This form of the disease is the one generally seen and its slow insidious nature is what makes it so much to be dreaded by horse owners. Acute glanders, when seen, manifests much the same symptoms as those seen in the chronic type, but in a greatly exaggerated form. Death is the result in a few days, or at most, in a few weeks.

There is one means by which glanders may be positively diagnosed and that is by inoculating other animals with the discharges. The guinea-pig shows a special tendency to contract glanders when the matter from an ulcer is introduced under the skin; but at the same time is particulary exempt from the effects of those other bacteria which infest the nasal discharges. In this way a pure case of glanders, easy of diagnosis, is produced in the guinea-pig and we also obtain a pure culture of the glanders "germ" which may be identified by cultivation and the use of the microscope.

TREATMENT.

No medicinal treatment can be recommended. I am not prepared to state that the disease cannot be cured, but the percentage of recoveries is extremely small. In fact, it is more than doubtful if any cases entirely recover. Therefore, the danger of spreading the disease, and the expense incured by an attempt at treatment more than out-weigh the value of the so-called recovered cases.

At present there is a State law which says that all horses diseased with glanders shall be destroyed, but the responsibility of enforcing it rests upon no person in particular, and moreover,

there is no veterinarian in the State whose duty it is to diagnose such cases. Hence, until proper provision is made by the State for effectually dealing with contagious and infectious diseases, every horse suspected of having glanders should be taken charge of by the local authorities of the township in which the case occurs. The nearest competent veterinarian should be called and his diagnosis promptly and properly acted upon.

There is but one correct method of dealing with this disease. That is to slaughter and burn, or bury deeply, all diseased animals, and, as far as possible, disinfect everything with which they have come in contact. All doubtful cases and those that have been "exposed" to the disease should be quarantined until a positive diagnosis can be made and the same precautions in the way of disinfecting rigidly observed.

Disinfection: The question of disinfection in such cases is one of great importance, not only from the standpoint of preventing the spread of the disease, but also on account of the actual cost of the procedure in each case. The point to be aimed at is thorough safety at the least possible outlay of money and labor.

The "germs" of all contagious and infectious diseases are killed with comparative ease by the ordinary disinfecting agents but in some cases, such as charbon for instance, these "germs" reproduce, or breed, by the formation of spores, or seeds, which resist the action of the usual disinfecting agents to a remarkable extent. In fact, they successfully resist the destructive action of boiling water for a long time and are, therefore, practically indestructible. Again, many of these disease-producing germs find a suitable "soil" for growth and development outside of the animal body in which they produce disease; hence it is practically impossible to completely stamp out the disease which they produce. Fortunately neither of these characteristics belong to the "germ" that produces glanders and consequently disinfection is a comparatively easy matter. But, before we can state just what is necessary in the way of disinfection we must first

learn the effects of those natural conditions of temperature and moisture which are usually present and operate to destroy, or preserve, the activity of the "germ". There is much diversity of opinion relative to the tenacity of the virus of glanders under natural conditions. Statements are sometimes carelessly made to the effect that stables where glandered horses were kept have, after having been empty for from six to eighteen months, communicated the disease to healthy animals. If such assertions were reliable we might infer that the "germ" of glanders produced permanent spores, but such is diametrically opposed to all our experimental knowledge relative to the tenacity of these germs and, moreover, is not supported by our actual experience with the disease. Viborg states that "if you dry glanders material at the ordinary temperature of the air, or in an artificial temperature conforming to that of Summer, it soon loses its infecting activity. Experiments with such material in over one hundred cases had no effect. Even subcutaneous inoculation gave negative results." Cadeac and Malet summarize the results of their experiments as follows: "First, the virus loses its virulency in matters exposed to free air after complete drying. Second, it is rapidly destroyed by warm weather, and, on the contrary, slowly by cold and damp. Third, the virus rapidly dried preserves its virulency longer than when dried slowly. Fourth, glandered matters placed in a medium saturated with humidity at the surrounding temperature preserve their activity for a long time. Fifth, the discharge of glanders dropped in watering places may preserve its activity for eighteen days. Sixth, the simple throwing of boiling water upon glandered discharges does not destroy its virulency, but this may be destroyed by a longer time in a much lower temperature." Renault, Bouley, Gerlach, Gaetier, and others have arrived at practically the same conclusions. Billings, however, by rapidly drying and carefully protecting the virus succeeded in preserving its activity for three months, but this is undoubtedly an exceptional case. Ordinarily thirty days exposure to the natural effects of the atmosphere will suffice to destroy the germs of this disease. But, as under very favorable conditions they may live longer it is, in practice,

necessary to see that none of those favorable conditions exist. The best artificial agents for destroying the virus of this disease are heat, carbolic acid, and corrosive sublimate. The first is effectual at 120 degrees but must be kept up for several minutes. Carbolic acid is rapidly fatal to the germ in a five per cent. solution, and corrosive sublimate is especially deadly in its effects on the virus in solutions of one part of the drug to 1000 of water. Its effects are, moreover, greatly augmented by the use of hot water in making the solutions.

Having considered the best natural and artificial means of destroying the virus of glanders we are now in a position to point out the best method for thoroughly disinfecting all utensils and stables, or other places, with which a glandered horse may have come in contact.

As before stated all diseased animals should be slaughtered, and either burned, or buried deeply. If the former method is pursued considerable wood or other inflammable substance must be used or complete combustion of the body will not take place. The method of burying deeply is more practical under the conditions surrounding the average case. In addition to being a less expensive method it is equally effectual if performed with ordinary care. No part of the body should be less than four feet under the ground and all blood, or discharge of any nature, which may have been scattered about should also be buried. If additional precautions are thought desirable all horses may be kept away from the place of burial for two months.

Where a positive diagnosis is impossible all suspected cases should be rigidly quarantined. To do this the animals must be placed in confinement and never allowed to leave the place until something definite can be ascertained as to the nature of the disease. All refuse matter from these horses should be kept from other animals and thoroughly disinfected by mixing with slacked lime or some other cheap disinfectant. Water buckets and other utensils used in the care of these suspected animals should not be used for any other purpose. The attendant should

not handle other horses without thoroughly disinfecting his hands or other parts of his person or clothing that may have come in contact with the suspected animals.

Horses known to have been exposed to the action of the virus of glanders should be quarantined in exactly the same manner as prescribed for the doubtful cases until sufficient time has elapsed to ascertain positively whether they have become infected. Just the exact time that it is necessary to quarantine these cases is perhaps largely a matter of opinion. The period of incubation, or time during which the virus remains in the system before producing symptoms of the disease, does not exceed ten days as a result of direct inoculation but by the natural infection this period is very indefinite, the authorities varying from ten days to two months. From this it is evident that a quarantine of less than sixty days is of very doubtful utility. The disinfection of all utensils, stables, and other places and articles with which glandered or suspected horses have come in contact should be carried out as follows: First, stables; All feed boxes, mangers, etc. should be removed and burned. The floors, walls, and other portions remaining should be thoroughly scrubbed with a boiling solution of corrosive sublimate,—1 part of corrosive sublimate to 1000 parts of water—or a solution of carbolic acid—1 part of acid to 20 of water. When this has been done and the stable allowed to dry for thirty days it should be thoroughly whitewashed and allowed to dry for two weeks longer. The feed boxes, mangers, etc. may now be replaced with new ones and the stable occupied with perfect safety. Second, water troughs, buckets, halters, etc. ; All watering places and articles of every description that have been used for horses affected with glanders should be thoroughly scrubbed with a boiling solution of corrosive sublimate or carbolic acid as described above and not used again for thirty days. If the measures herein recommended be fully adopted and rigidly carried out any and all outbreaks of the disease may be thoroughly controlled.

In this bulletin our aim has not been to present original facts,

but merely to offer in a plain and condensed form those facts already known concerning the disease; in order that the average stockman may be able to recognize well marked cases and deal with them intelligently.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 17.

Insects Injurious to Stored Grain.

HOWARD EVARTS WEED.

AGRICULTURAL COLLEGE, MISS.,

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The bulletins of the Station are sent free of charge to all farmers in Mississippi who apply for them.

THE ANGOUMOIS GRAIN MOTH.

(*Gelechia cereallella, Oliv.*)

This insect has caused much damage to stored grain in this state for many years. At the Station during the past year it has been exceedingly destructive, wheat put into the barns in June being entirely destroyed by September. It attacks wheat and corn especially, but other grains are by no means exempt.

HISTORY AND DISTRIBUTION.

The first extensive account of the habits of this insect was given in 1736 by Reaumur, a French naturalist, who found it very destructive to barley at Lucon, France. In 1760 it was very destructive to wheat in the province of Angoumois, and Harris states that "the afflicted inhabitants were thereby deprived not only of their principal staple, wherewith they were wont to pay their annual rents, their taxes, and their tithes, but were threatened with famine and pestilence from the want of wholesome food." Two members of the Paris Academy of Sciences were commissioned by the French Government to visit the province of Angoumois to investigate the habits of this insect, and since the publication of their report the insect has received the popular name of "The Angoumois Grain Moth." The insect is very destructive throughout southern Europe at the present time, and has become a well known pest.

The first record of its appearance in this country was made in 1768 by Col. Landon Carter of Sabine Hall, Virginia, in an article published in the Transactions of the American Philosophical Society, in which it was stated that the insect had been noticed in North Carolina some forty years before and had spread from there into Virginia, Maryland, and Delaware (Harris). Since the publication of this article, various writers have recorded its appearance in most of the Eastern States. It is most abundant however throughout the Southern States, where it yearly causes great damage to grain before, as well as after, it is gathered. In the Northern States it is not so abundant, the cooler temperature retarding its growth.

DESCRIPTION.

The imago or mature form of this insect is a small moth, shown at *c* in Fig. 1. The wings expand slightly over one-half inch in length, and the antennæ are nearly as long as the body, tapering at the extremity. The body and fore-wings are of a light gray color and have a soft shiny appearance; the hind-wings are of a darker hue than the fore-wings, narrow, and tapering to a point at the outer ends. The outer posterior extremities of the fore-wings bear light gray colored scales which are thickest near the tip of the wings. The fringe surrounding the hind-wings is of the same color as the wings, being shortest at the outer anterior extremity (when the wings are outspread as in the figure) and longest at the inner posterior edge. The underside of the wings is much darker than the upper side. The legs are slightly darker than the body, the posterior pair being quite hairy and each bearing two prominent spurs.

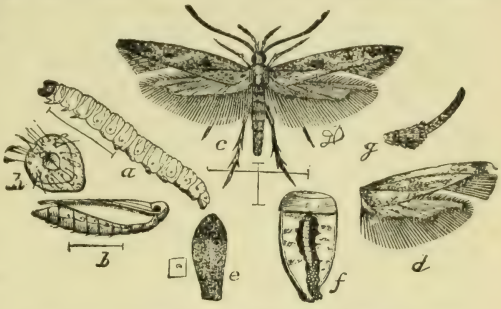

FIG. 1—ANGOUMOIS GRAIN MOTH.
Enlarged. (After Riley.)

An enlarged egg is shown at *e* in Fig. 1. According to Riley it is very small, flat, and oval, of a pale red color with prismatic reflections.

The larva is of a light color and measures about one-fourth inch in length when full grown. It is shown at *a* in Fig. 1. The head is brown and the body gradually tapers posteriorly from the second segment. The body bears many light colored hairs, those upon the first and last segments being the longest. Each of the first three segments of the body bears a pair of true legs while each of the sixth, seventh, eighth, ninth, and last segments bears a pair of prolegs. The prolegs are small and terminate in minute hooks.

The pupa, which is nearly one-fourth of an inch in length, is shown at *b* in Fig. 1. The anterior portion and wing pads are dark brown, the abdomen being somewhat lighter. The wings reach nearly to the posterior extremity, and the eyes, which are plainly visible, are black.

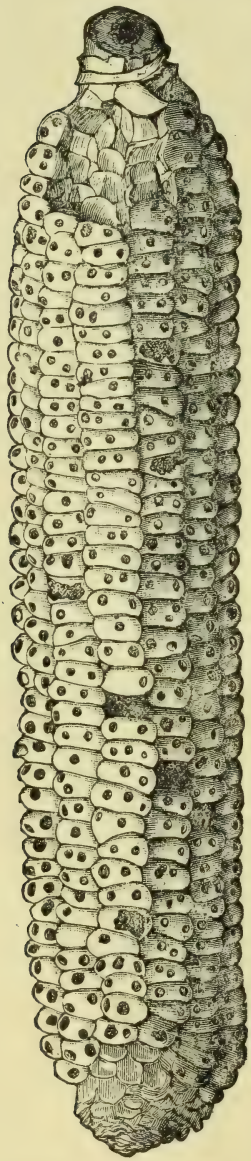

FIG. 2—EAR OF CORN.
Reduced. (After Riley.)

LIFE HISTORY AND HABITS.

The moths are nocturnal in their habits and the eggs are laid either upon standing grain in the field or when stored in the granary or cribs. When deposited upon corn the eggs are generally placed under the thin membrane at the base of the seed. They are also laid in the grooves or depressions in the seed, singly as a rule, or sometimes in clusters.

From the egg is hatched, in a few days, the young larva, which immediately bores into the grain, where it eats the farinaceous portion leaving but a thin shell. The small hole through which the larva entered becomes closed by its excrement so that to all appearances the grain may be sound although consisting of but a thin shell. The infested grain is easily detected, however, by its light weight, and if a few seeds are thrown into water those infested will rise to the surface. In wheat and other small grains but one larva is found within a seed, but in corn several are often found. It is probable that in the smaller seed the larvæ often devour their own excrement.

The length of life in the larval state will vary according to temperature, and when mature, the larvæ form the pupa within the grain, first boring a small hole to the exterior for the escape of the moths. In a few days or weeks, according to the temperature, the moths make their escape and lay the eggs for another brood.

The number of annual generations will vary according to climate and temperature. Harris states that there are but two broods in Massachusetts and this is doubtless the case in all the Northern States. In this state, however, there are at least eight annual generations. In warm weather it takes but a month to

pass from the egg to the moth, and the various stages of the insect can be found in infested grain at all times of the year. There are thus no stated periods at which the moths come forth, and if a quantity of infested grain is put in a glass jar and covered with a piece of cheese cloth, the moths will continue to issue from the grain for a long time.

The insects reproduce so rapidly that it takes but a short time to destroy the grain when stored. In Fig. 2 is shown an ear of corn from which the moths have escaped. The nutritious portion of the grain is entirely eaten, and infested grain will not germinate.

PARASITES.

Several European writers upon this subject mention parasites which prey upon the larvæ of this insect. In 1882 Mr. F. M. Webster found a small mite (*Heteropus ventricosus, Newport*) destroying large numbers of the larvæ of this insect in Illinois. The mites are exceedingly prolific and kill the grain moth larvæ by piercing the skin and sucking the juices. Small numbers of this mite were found in some infested wheat at the Station barn during October and it is probable that they destroy large numbers of the grain moth larvæ.

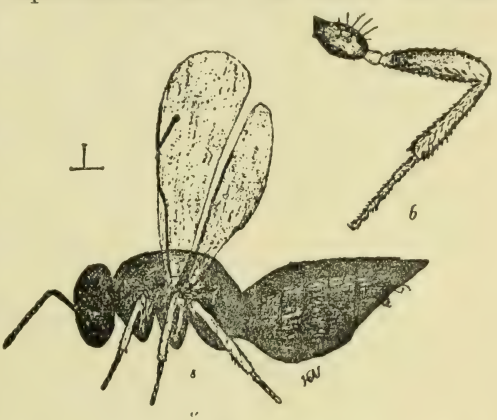

FIG. 3—PARASITE OF GRAIN MOTH. Enlarged.

Mr. Webster also describes a chalsid parasite, *Pteromalis gelechiæ*, which attacks the larvæ of this insect, and some infested wheat brought into the laboratory in October contained large numbers of this parasite. About an equal number of parasites and moths issued from the infested wheat showing that the parasites do immense good in keeping the grain moths in check.

This parasite is shown in Fig. 3, and is a small, black, fly-like, insect with four transparent, almost veinless wings. The antennæ are quite long, of a yellow color, the head broad, eyes prominent, abdomen triangular and the legs light yellow or nearly white. The male is somewhat short-

er than the female, being slightly less than one-tenth of an inch, with an obtusely triangular abdomen. The female is little over one-tenth of an inch long and the abdomen is acutely triangular.

THE BLACK WEEVIL.

(*Calandra oryzæ, Linn.*)

This insect is probably a native of the East Indies where it is known as the "Rice Weevil," and for nearly a century has there been a well known pest. It is now, like most grain insects, cosmopolitan, being especially abundant in tropical climates. In the northern United States it is almost unknown, but in the South it is a serious pest.

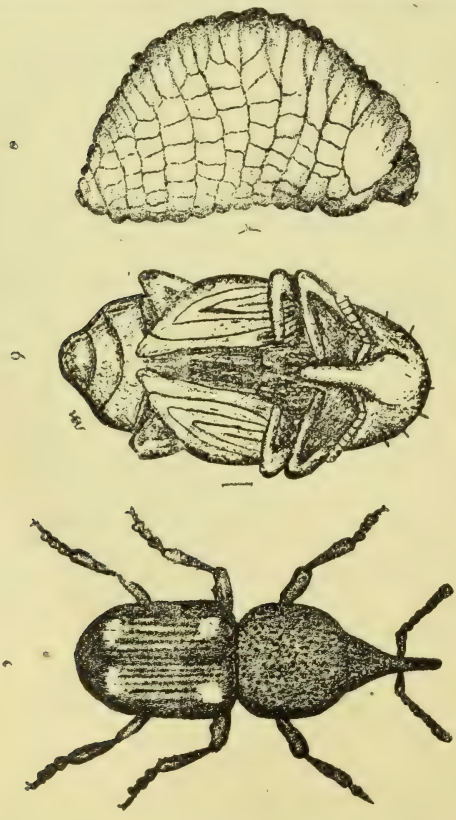

FIG. 4—BLACK WEEVIL. Enlarged.

DESCRIPTION.

The mature insect is shown at *c* in Fig. 4. It is about one-eighth of an inch long, black, with four light brown or reddish spots at the corners of the elytra or wing cases. The surface of the body is indented, and upon the elytra these indentations are arranged in rows. The mouth parts are at the end of a long snout and the antennæ elbow from this snout as seen in the figure. The eggs are quite small, elongate, and translucent.

The larva is shown at *a* in Fig. 4 and when full grown is about one-eighth of an inch long. It is a footless grub with a white body and brown head. The body is nearly cylindrical, curved as shown in the figure, and along

the back is broader than beneath. The pupa is about the same length as the larva and is shown at *b* in Fig. 4. It is of a light color and the antennæ, fore-legs and wing cases are plainly visible, the posterior legs being partly folded beneath the wing cases.

LIFE HISTORY AND HABITS.

This insect is found in the grain in the field, but does its greatest damage after the grain has been gathered. Although attacking other grains it injures corn more than any other and an ear attacked has nearly the same appearance as that shown in Fig. 2, where the attack was made by the Angoumois grain moth.

The females make punctures by means of their snouts in the kernels within which the eggs are laid, several being sometimes laid in one kernel. In a few days these hatch and the young larvæ feed upon the inner portion of the kernels, and, when mature, the pupæ are formed by a shedding of the larval skin. In about two weeks the mature weevils are produced and these, after pairing, lay eggs for another generation.

The length of time required for the change from the egg to imago varies from three weeks to two months or over, varying according to temperature. In a warm, even temperature the increase of the weevils is quite rapid, while cold weather greatly retards their growth. There are no distinct broods of these insects, although there are probably at least eight annual generations. The insect in all stages of egg, larva, pupa, and imago can be found at all times in infested corn. The period of egg laying of a single female is quite long, sometimes several weeks.

The black weevils damage corn as much in the imago state as in the larval, as, not content with eating out the center of the kernels as larvæ, the mature weevils eat into the kernels indiscriminately. Even greater damage is done by the weevils than by the larvæ.

It is probable that the black weevils produce an injurious action upon the stomach when corn infested with them is fed to stock, and according to Riley cases are "on record where human beings have suffered, even unto death, from the use of flour made from wheat badly infested with the closely allied species (*granaria*), and the chitinous covering is not only indigestible, but must be very irritating also."

PARASITES.

Mr. L. O. Howard has described a chalcid parasite upon this insect under the name of *Pteromalis calandræ* which closely resembles the *Pteromalis gelechiæ*, shown in Fig. 3.

It is not a common parasite however, and has not yet been observed here.

THE RED GRAIN BEETLE.

(*Silvanus cassiæ, Reiche.*)

This is the small, flat, elongate, red beetle so common in stored grain in the South. Most of the members of the family Cucujidæ, to which this beetle belongs, have their natural habitat under bark, although some species are found in various commercial products.

DESCRIPTION.

The imago is about one-tenth of an inch long with a flat body, slender legs, club shaped antennæ, and of a reddish-brown color. It is shown at *c* in Fig. 5, the line at the right showing the natural length.

The larva, shown at *a* in Fig. 5, is about one-tenth of an inch in length when full grown, and is somewhat flattened. The body is of a light color, somewhat darker than the larva of the black weevil, and with a slightly yellowish tinge. The head is brown and the legs, six in number, are pointed and darker than the body.

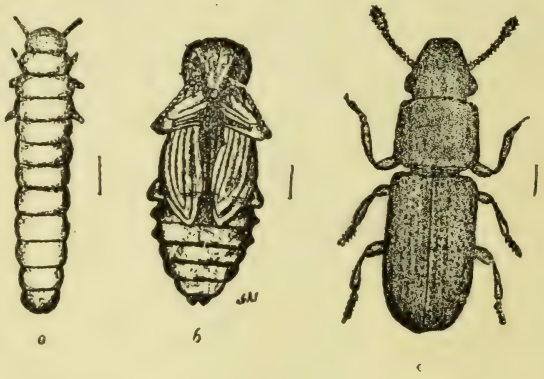

FIG. 5—RED GRAIN BEETLE. Enlarged.

The pupa is about the same length as the larva and of the same color and is shown at *b* in Fig. 5. The club-shaped antennæ are folded between the fore and middle legs and are plainly visible.

LIFE HISTORY AND HABITS.

The small white eggs are laid at the base of the kernels of corn and the larvæ hatching in a few days from these bore into the kernels at the soft portion near the base. Several larvæ may enter the same kernel, it not being uncommon to find a half dozen in one seed.

When mature, or in about three weeks, the larvæ form pupæ within the seed from which the beetles escape in

about two weeks. There are probably eight to ten annual generations of this beetle, and it is not so much affected by cold weather as is the black weevil.

In infested corn these beetles are seen upon the husk or at the base of the kernels. They are quite lively and when an ear of corn is husked they seek protection between the kernels. They are gathered with the corn in the autumn and increase quite rapidly after the corn is stored. The presence of the larvæ within the kernels is not easily detected from external appearances, as they eat, as a rule, only the softer middle portion of the seed.

THE CORN SAP-BEETLE.

(*Carpophilus pallipennis, Say.*)

This insect belongs to the family Nitidulidæ, the members of which, as a rule, feed upon flowers, fungi, and dry decaying vegetable matter and are often found under the bark of trees. Some species, however, have been reported (see *Insect Life*) as feeding upon figs and raspberries. They receive the common name "Sap-beetles" owing to their entering fruit which has been previously injured by other insects or orther causes.

DESCRIPTION.

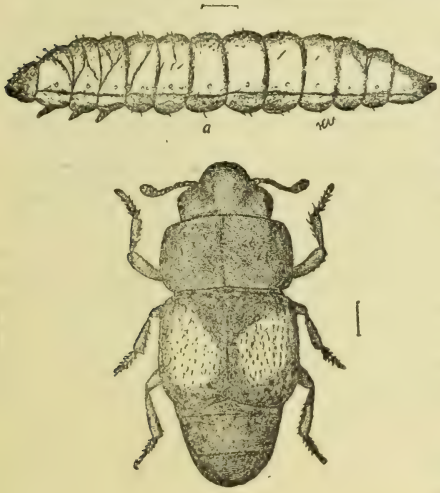

Fig 6—Corn Sap-Beetle. Enlarged.

This beetle, shown at *b* in Fig. 6, is about one-seventh of an inch long, of a brownish-black color, club-shaped antennæ, and light reddish-brown wing cases which do not fully cover the abdomen.

The larva is shown at *a* in Fig. 6 and is about one-seventh of an inch long. It has a brown head and a few sparsely placed hairs upon the body. It is readily distinguished from the larva of the red grain beetle by being slightly larger and more cylindrical.

HABITS.

This beetle is very common late in the summer and autumn. It is especially numerous where the ears have been injured by boll worms, and it is probable that they are attracted to the ears by the decay of the grain caused by the work of these insects. As a rule they feed only upon the dry decayed kernels at the upper extremity of the ears, but they will also feed upon sound corn, in which case the larvæ are found within the seed as in the case of the other grain insects.

The corn sap-beetle is most common upon corn in the field, but it is also found in the corn throughout the winter when stored. This insect cannot be said to be very injurious for, as already stated, it feeds mostly upon the dry decaying kernels at the upper portion of the ear.

OTHER GRAIN INSECTS.

Among the other insects injurious to stored grain may be mentioned the following:

Silvanus surinamensis, Linn., is a small, flat, brown beetle very much resembling the red grain beetle, but readily distinguished from it by the saw-like edges of the thorax. This beetle is shown in Fig. 7 and, as seen from the illustration, the thorax has three very prominent longitudinal ridges while the wing cases bear several less prominent ridges. It is often found along with the red grain beetle and in some localities causes considerable damage.

Fig 7—Surinamensis Grain Beetle. Enlarged.

FIG. 8—Brown Grain Beetle. Enlarged.

Tribolium ferrugineum, Fab., is a small beetle which feeds upon dried animal and vegetable matter. It is quite common in museums and at the Station is a troublesome pest in the insect collection. It is shown in Fig. 8, and, as its name *ferrugineum* implies, is of a light brown color. It is readily distinguished from the red grain beetle

by being slightly larger and not as flat. In the granary it is sometimes quite common, especially in the spring.

Calandra granaria, Linn., the common grain weevil, resembles very much the black weevil but is slightly larger and lacks the red spots upon the elytra. Its habits and depredations are the same as those of the black weevil, and although sometimes found in the South, it is less common here than in the Northern States.

REMEDIES FOR GRAIN INSECTS.

As the remedies for all the insects infesting stored grain are nearly similar, they are given here rather than separately at the end of each article.

The Angoumois grain moth having been such a well known pest in Southern Europe, insect mills, resembling a large coffee roaster, are constructed in which the grain is heated for a few hours, whereby the grain moth in its various stages is destroyed. Large machines are also built in which the grain is violently agitated by means of which the insects are destroyed.

Many claim that China berries (*Melia azederach*) placed in corn cribs will tend to keep the weevils out and drive away those already in the corn. To test this a quantity of China berries were placed in a quantity of husked corn infested with the black weevil. An examination of the corn several weeks afterwards showed the weevils present fully as numerous as before. This being the case it is probable that the berries have but little effect either in driving the weevils away or in preventing their breeding.

Experiments with sulphur and salt proved both these substances effective in ridding the infested corn of the black weevils and the flat grain beetles. These substances were sprinkled upon husked corn quite freely and an examination a few days later showed none of the insects present in either crib. The same amount of these two substances placed upon corn in the husk in other cribs produced no effect upon the insects, as they were protected by the husk.

Many farmers throughout the South protect their corn by leaving an open place in the center of the roof of the corn cribs, so as to allow the rain to thoroughly wet the corn. It is claimed that this causes the corn to go through a process of heating during which the weevils are killed. If there is good drainage at the bottom of the crib the corn will not be spoiled by mould. This is said by those who practice it to be a thorough remedy but opportunity for a

trial on an extended scale has not presented itself at the Station.

The best method of destroying grain insects, however, is by the use of bisulphide of carbon. Attention was first called to the use of this substance on a large scale by Dr. C. V. Riley in the "Farmer's Review" in March 1879, in an article upon the Rice Weevil. In this article Dr. Riley advocated putting the grain in a tight bin and treating each ton of grain with a quarter to half an ounce of the bisulphide by placing the bisulphide in an open dish on top of the grain and allowing it to evaporate.

Another method of applying the bisulphide is by means of a long tube or piece of pipe in which is a tight fitting rod. Push one end of the tube into the center of the grain, withdraw the rod, pour the bisulphide down the tube, after which the tube may be withdrawn. If a tight fitting rod cannot be obtained, a plug can be put into one end of the tube and after this end has been pushed into the grain the plug can be loosened with a rod or stick. The bisulphide is then poured in as before. It will not be necessary that the bisulphide be put into the bottom of the bin as it is heavier than air. The object of putting it near the center of the grain is to secure as even a distribution as possible.

Recently Prof. A. P. Church has published in the Kew Bulletin another method of applying this substance. "A ball of tow is tied to a stick of such a length that it can just be plunged into the middle of the vessel containing the grain. The tow receives the charge of bisulphide like a sponge and is at once plunged into the sack or cylinder and left there, the mouth being tightly closed." Cotton is an excellent material to receive the charge of bisulphide. A quantity of cotton should be securely tied to the end of a long stick and after the bisulphide is poured upon the cotton it should be pushed into the grain. The amount necessary will vary according to the tightness of the bin. If the bin is not tight or nearly so the bisulphide remedy will not be successful. In a tight bin, one ounce bisulphide to one hundred pounds of grain, or one pound to the ton, will suffice. If the grain is in a bin open at the top a thick blanket should be placed over it to confine the fumes of the bisulphide as much as possible. Should the first charge of the bisulphide fail to kill all the insects within the grain the ball of cotton can be withdrawn and the charge renewed.

In wheat, oats, and shelled corn, the last method of treatment is excellent, as the ball of cotton containing the charge of bisulphide can be very readily placed near the center of the grain. Corn not shelled, however, is best

treated by putting the bisulphide in an open dish or sprinkling it over the top of the grain.

Care should be taken in using the bisulphide, as it is an explosive substance. Lamps, lighted cigars, and the like, should not be brought near where it has been used, but if care is taken that no light is brought near until the odor of the bisulphide has passed away, there is perfect safety in using this remedy.

Corn treated by means of the bisulphide of carbon should in all cases be husked, as the husk affords such protection to the insects attacking the grain that a much larger amount is necessary in the treatment of corn in the husk than would otherwise be the case. If the corn is shelled the action of the bisulphide is still more effective.

If no tight bin suitable to treat the grain by means of the bisulphide of carbon is present upon a farm a small "quarantine" bin should be built for this purpose. When gathered the grain should be put into this bin, treated by means of the bisulphide, after which it can be placed in other bins or cribs. When treated, the grain should be left in the bin a day or until the odor of the bisulphide has passed away. The insects being within the grain when gathered if it is all treated at this time further treatment will not, as a rule, be necessary.

Grain treated with the bisulphide of carbon is not injured in any way, as the germinating power of the seed remains intact, and odor from the bisulphide will pass away in a few days.

The bisulphide of carbon is best obtained direct from the manufacturer, Edward R. Taylor, Chemist, Cleveland, Ohio, who sells it in fifty pound cans at ten cents per pound. It can be obtained in small amounts at the drug stores at twenty to twenty-five cents per pound, but as it should be kept on hand for use at any time, obtaining it direct from the manufacturer will be much cheaper.

To destroy insects infesting mills, quantities of the bisulphide should be placed in open dishes or plates in various elevated parts of the mill, and by means of a sprinkler bisulphide should be applied to the waste, commencing the application in the basement and going upward. The mill should then be closed as tightly as possible and a watchman employed to see that no lights are brought near until the odor of the bisulphide has passed off. If a mill is thus treated on Saturday afternoon, work can be resumed as usual on Monday morning. The bisulphide should not be applied to an unpainted floor or wall as it will soak into the

wood and it will take sometime before the fumes will have passed away.

P. Morris and Son, millers of Lebanon, Indiana, in a recent letter relate their experience in the use of bisulphide as follows:

"We commenced in the attic and the fumes were so powerful that they drove us out before we succeeded in placing it where we desired to in the lower stories. So we would advise to begin in the basement and go up, then you will be working above the fumes all the time and will only have to pass through them in going out of the building. Whenever we could place it where we knew there were plenty of insects it killed them all. We think to saturate waste is an excellent way to apply it—is easily placed wherever you want it and evaporates readily."

In the spring the granaries swarm with large numbers of grain insects ready to escape to begin their depredations upon the grain in the field. At this time large numbers can be readily killed in the granary by means of the bisulphide of carbon, or by kerosene applied with a hand force pump or a common watering pot. If the insects are thus killed in the spring it will greatly decrease the damage done the following fall and winter.

SUMMARY.

1. The three principal insects injurious to stored grain in the South are the Angumois grain moth, the black weevil, and the red grain beetle.

2. The transformations and habits of these insects are essentially the same, the eggs being laid within the grain both before and after it is gathered, and the mature insects coming forth in about three to six weeks after the eggs are laid.

3. Their depredations are not confined to any one cereal, and by their work they cause a marked decrease in the weight of the grain.

4. Other insects are sometimes found in stored grain, but as a rule are not common in this state and hence cause but little injury.

5. If sulphur or salt is sprinkled in husked corn it will tend to drive the insects away.

6. Many farmers leave an open space in the roof of the corn cribs to allow the rain to soak into the corn which causes a heating of the grain during which it is claimed the weevils are killed.

7. China berries placed in corn seem to have but little effect in keeping the corn free from the black weevils.

8. The best remedy for grain insects is by the use of bisulphide of carbon. For this purpose a "quarantine" bin should be built, and the grain treated with the bisulphide in this bin as it is gathered.

9. The amount of bisulphide will vary with the tightness of the bin, as a rule one ounce of bisulphide to one hundred pounds grain being sufficient.

10. As the bisulphide is explosive, lights from matches, cigars, and the like, should be kept away until the odor of the fumes have passed off.

11. The cost of the bisulphide is ten cents per pound when obtained direct from the manufacturer.

12. Insects in mills should be treated with the bisulphide, commencing the application in the basement and going upward.

13. In the spring the insects in the empty or nearly empty granaries should be killed by means of the bisulphide or kerosene, which will largely decrease the damage the following fall and winter.

A NOTE OF PROGRESS.

Since the first edition of this bulletin was printed, in December, 1891, we have continued our experiments with the use of bisulphide of carbon for grain insects, and it has been our practice to apply it by simply pouring it over the top of the grain, and we now recommend this method of application as being the best. Since the bisulphide was first recommended for grain insects in 1879, most writers have estimated that an ounce was required to treat one hundred pounds of grain. It has been our experience, however, that one pound to one hundred bushels of grain is amply sufficient to destroy all insects within the crib. This has been the case even when the grain was in an open crib, making the cost of treatment only ten cents per hundred bushels. In our later work the fuma bisulphide, a grade recently introduced by Mr. Taylor, was used, this being much more effective than that which was formerly upon the market.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 18.

Varieties of Cotton.

E. R. LLOYD.

AGRICULTURAL COLLEGE, MISS.

JANUARY, 1892.

VARIETIES O

The following table gives the yield, quality, and total value per acre in 1891. All were grown on low land which was well drained and in good c

NAME.	Addresses of Parties from Whom Seed was Secured.	Date of Heaviest Picking.	Weight of Seed Cotton per Acre—Lbs.	Weight of Seed, Pounds.
Allen	J. B. Allen, Port Gibson, Miss	September 24	970	71
Allen	Alexander Seed Co., Augusta, Ga	Sept. 24	970	70
Bailey	N. D. Guerry, Artesia Miss	Sept. 23	890	60
Bailey	T. J. King, Louisburg, N. C	Sept 23	1200	81
Ben Smith	B F Smith, Redwine, La	Sept, 25	770	50
Big Boll	California Experiment Station	Oct 1	380	24
Boyd's Prolific	H. C. Prevost, New Orleans, La	Sept. 24	1060	73
Catawba	W. R Davis, Landsford, S. C	Oct 10	760	48
Cherry Long Staple	Louisiana Experiment Station	Sept. 24	1050	73
Cochran's Extra Prolific	M. W Johnson Seed Co., Atlanta, Ga.	Sept. 23	1000	67
Cook	W A. Cook, Newman, Miss	Sept 21	500	35
Dearing	H. P. Jones, Herndon, Ga	Oct. 28	730	48
Dickson	Capers Dickson, Oxford, Ga	Oct 10	660	45
Drake's Cluster	R W Drake, Laneville, Ala	Oct 10	1250	80
Ellsworth	W N. Ellsworth, Wallace, N. C	Sept. 21	740	49
Eureka	A S Coltharp, Milliken Bend, La	Sept. 23	1080	77
Eureka	D. G. Humphrey, Dalkeith, La	Sept 23	1050	75
Excelsior	C R. Ezell, Eatonton, Ga	Oct. 10	710	46
Extra Early Carolina	D Landreth & Sons, Philadelphia, Pa	Sept. 23	740	51
Gunn	C L. Gunn, Bailey, Miss	Sept. 23	620	43
Hawkins' Improved	B W. Hawkins, Nona, Ga	Oct 10	420	27
Herlong	Alexander Drug & Seed Co., Augusta, Ga	Oct. 28	810	56
Hilliard	W. A. Hilliard, Bowersville, Ga	Sept 21	550	38
Hunnicutt	J. B Hunnicutt, Atlanta, Ga	Sept. 21	610	43
Jones' Long Staple Prolific	J H Jones, Herndon, Ga	Sept 21	730	50
Kelly	J J Halbert, Terry, Miss	Sept. 16	660	43
King	T. J King, Louisburg, N. C	Sept. 10	1080	7
Magruder Marvel	I. D. Magruder, Russum, Miss	Oct. 10	550	37
Mammoth Prolific	Johnson's Seed Co , Atlanta, Ga	Oct. 10	560	38
Marston's Prolific	H C Prevost, New Orleans, La	Oct. 10	960	66
Okra Leaf	Alexander Seed Co , Augusta, Ga	Sept. 23	820	5
Peerless	H. P. Jones, Herndon, Ga	Oct. 28	780	5
Peterkin	U. S Department of Agriculture	Oct. 28	930	5
Peterkin Improved	J H. Jones, Herndon, Ga	Sept. 23	970	6
Petit Gulf	H. C. Prevost, New Orleans, La	Sept. 24	970	6
Petit Gulf	Louisiana Experiment Station	Oct. 10	1050	7
Poor Man's Relief	California Experiment Station	Oct 10	710	4
Shines' Early Prolific	T. W. Wood & Son, Richmond, Va	Sept. 23	820	5
Sea Island	Mississippi Experiment Station	Oct 10	430	3
Smith's Standard Improved	Johnson Seed Co., Atlanta, Ga	Sept. 23	990	6
Southern Hope	E J McGehee Pinckneyville, Miss	Oct 10	610	4
Tennessee Gold Dust	Jenkins & Trobaugh, Brunswick, Tenn	Sept 24	760	4
Texas Storm Proof	W J Smillie, Baileyville, Texas	Sept 24	1370	9
Truitt's Imp. Premium Prolific	G. W. Truitt, La Grange, Ga	Sept. 23	690	4
Truitt's Premium	G. W. Truitt, La Grange, Ga	Oct. 1	6.0	4
Welborn's Fancy Pet	Jeff Welborn, New Boston, Texas	Sept. 10	540	3
Welborn's Pet	Jeff Welborn, New Boston, Texas	Sept. 10	660	4
Wilczinski	B. F. Gray, Wilczinski, Miss	Sept. 16	730	4
Willis	J B Allen, Port Gibson, Miss	Sept 24	870	6
Wonderful	J H Jones, Herndon, Ga	Sept. 23	380	2

Average Weight per Acre of Seed Cotton, 796 lbs. Average Weight per A

Average Value per Acre of Lint, 20.23. Average Value per Acre of Se

COTTON--1891:

forty-six varieties of cotton which were grown by the Experiment Station
dition, but no fertilizers were used.

Weight of Seed.	Per Cent. of Lint to Seed Cotton.	Price per Pound, Cents.	Value of Lint, Dollars.	Value of Seed, Dollars.	Total Value of Crop, Dollars.	CLASS.	STAPLE.
5	26 49	11	$28 16	$2 14	$30 30	Middling to strict middling	Good staple
0	27 83	13 1-2	36 45	2 10	38 55	Strict middling	1 1-2 staple
4	31 92	8 1-4	23 43	1 82	25 25	Strict to good middling	1 3-16 staple very good
6	32 13	8	30 88	2 44	33 32	Strict middling	1 3-16 staple
6	34 11	7 1-16	18 59	1 52	20 11	Strict middling	Fair staple
2	34 72	7 1-4	9 57	74	10 31	Fully strict middling	Good staple
0	31 16	7 1-4	23 93	2 19	26 12	Strict middling	Good staple
1	35 71	7 1-16	19 14	1 47	20 61	Strict middling	Fair staple
4	29 92	7 1-8	22 37	2 21	24 58	Middling to strict middling	Good staple
9	32 87	7 1 8	23 44	2 01	25 45	Strict Middling	Fair staple
5	28 53	12 3-4	18 25	1 07	19 30	Strict middling	1 7-16 staple
5	33.24	7 1-2	18 23	1 46	19 69	Strict to good middling	Good staple
0	31.81	7 1-8	14 96	1 35	16 31	Strict middling	Fair staple
6	30 85	7 1-8	29 50	2 59	30 09	Strict middling	Good staple
7	33 35	7 1-16	17 44	1 48	18 92	Strict middling	Poor staple
6	28 96	10	31 60	2 32	33 92	Strict middling	1 1-4 staple
7	28.31	12 1-2	37 13	2 26	39 39	Strict middling	1 3-8 staple
1	33 88	7 1-16	17 02	1 41	18 43	Strict middling	Poor staple
9	30 90	7 1-8	16 31	1 53	17 85	Strict middling	Fair staple
3	31 15	7	13 51	1 28	14 79	Strict middling	Fair staple
0	37 70	7	10 22	82	11 04	Strict middling	Short staple
4	35.08	6 7-8	16 77	1 70	18 47	Middling	Flimsy staple
7	33 41	7 1 4	14 28	1 18	15 46	Strict middling	Good staple
9	30.95	7 1-8	13 47	1 26	14 73	Strict middling	Fair staple
2	30 47	9	19 98	1 52	21 50	Strict middling	1 1-4 staple
2	35 16	7 1-8	16 53	1 28	17 81	Strict middling	Fair staple
7	31 02	7	25 69	2 14	27 83	Strict middling	Poor staple
5	31 85	7 1-16	12 36	1 12	13 48	Strict middling	Fair staple
6	31 47	7 1-8	12 54	1 15	13 69	Strict middling	Fair staple
01	30 27	7 1-8	20 73	2 01	22 75	Strict middling	Good staple
2	33 16	8 1-4	22 44	1 64	24 08	Strict middling	1 3-16 staple
5	32.74	7 1-8	18 17	1 57	19 74	Strict middling	Good staple
0	37 66	7	24 50	1 74	26 24	Strict middling	Short staple
0	31 99	7	21 70	1 98	23 68	Middling	Fair staple
2	31 15	7 1-4	21 89	2 01	23 90	Strict middling	Good staple
7	31 15	7 1-4	23 71	2 17	25 88	Middling to strict middling	Good staple
2	34.06	7 1-2	18 15	1 41	19 56	Strict middling	Good staple
7	33 81	7 1-16	19 56	1 63	21 19	Strict middling	Poor staple
7	29.52	15	19 05	91	19 96	Strict middling	1 3-4 staple
1	33.41	7 1-8	23 58	1 98	25 56	Strict middling	Good staple
2	29 85	10 1-2	19 11	1 28	20 39	Strict middling	1 5-16 staple
1	34 39	7 1 4	18 92	1 50	20 42	Strict middling	Good staple
8	32.69	7 3-8	33 04	2 77	35 81	Strict middling	Good staple
5	32.68	7 1-4	16 31	1 40	17 71	Strict middling	Good staple
1	32 43	7 1-16	14 19	1 26	15 45	Strict middling	Fair staple
7	32 82	7 1-16	11 79	1 03	12 82	Strict middling	Fair staple
9	34.85	7 1-8	16 39	1 29	17 68	Strict middling	Fair staple
3	33 34	7	17 01	1 46	18 47	Strict middling	Fair staple
2	27.77	10 1-2	25 41	1 89	27 30	Strict middling	1 5-16 staple silky
1	29 54	12 1-2	14 09	81	14 81	Strict middling	1 7-16 staple

of Lint Cotton, 254 lbs. Average Weight per Acre of Seed, 542 lbs.

33. Average Value per Acre of Crop, 21.86.

It will be seen from the table that the five varieties producing the highest values per acre were "Allen" $34.43 (average of two lots); "Bailey" $33.32; "Drake's Cluster" $30.09; "Eureka" $36.66 (average of two lots); "Texas Storm Proof" $35.81.

The grades and prices on which these values are based were fixed from samples sent to the New Orleans Cotton Exchange on December 31st, "middling" cotton being worth seven cents on that date, and the seed is valued at thirty cents per one hundred pounds.

Details of this and other work with cotton will be given in the Annual Report of the Station, which will be published February 1, but in order that planters may have the advantage of the work in selecting varieties for planting the present year, it is thought best to publish this at once. The Station, has no seed of any of the varieties for sale or distribution, but the addresses of the parties from whom our supply was purchased last year is given in the second column of the table.

[illegible]

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 19.

The Southern Tomato Blight.

BYRON D. HALSTED,
Special Assistant.

AGRICULTURAL COLLEGE, MISS.

JANUARY, 1892.

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The bulletins of the Station are sent free of charge, to all farmers in this State who apply for them.

THE SOUTHERN TOMATO BLIGHT.

[NOTE. For several years the tomato growers of Mississippi have suffered serious losses from the prevalence of an unrecognized disease which, in some cases, has destroyed from one-fourth to one-half of the plants. The cause of the disease was wholly unknown, and none of the preventives used seemed to have any effect. In 1890 the losses from this cause were so severe and so wide spread, that in May, 1891, the Trustees of the Station secured the assistance of Dr. Byron D. Halsted of the New Jersey Station, in an endeavor to ascertain the cause of the disease, as a necessary preliminary to intelligent work with preventives and remedies. Dr. Halsted has been working on similar diseases of plants for many years, and the Trustees knew of no one else who was so well qualified for the work, or upon whose conclusions more reliance could be placed. He commenced his work at the Ocean Springs branch station on May 5, five days after the disease made its first appearance there for this season, and remained there until the weather became so dry as to make further operations in the field impossible. He then examined the fields in several other portions of the state, after which he returned to New Jersey and continued the work in his laboratory until the close of the season. He will continue the investigation during the coming year, both in the field and in the laboratory, but in order to place on record the results already secured, and to assist others who are working in the same line, it is thought best to publish now his report of the work done in 1891, although it is necessarily incomplete.—S. M. TRACY, Director.]

As this disease has been, until the past year or two, most injurious in the gulf states therefore, for the sake of avoiding confusion, it may be termed the "Southern Tomato Blight." While known for several years, it was not until 1889 that it assumed proportions causing alarm among the growers of the tomato.

The blight is quickly recognized by a wilting of the plant and particularly of the young upper leaves and the growing tips of the stem. Usually the older leaves have turned yellow and hang lifeless from the stems before the wilting is noticed. If the plant has two or more branches reaching below the surface of the ground it is not infrequent that only one will at first show the wilting or blighting.

Upon closer inspection it is found that patches of the stem and adjoining leaves of the diseased plants have a moist appearance as in the so-called "water-core" of apples. Such stems, when cut lengthwise, show a very watery pith which, on account of the excessive moisture, has a greener color than that of the center of a normal stem. This watery, greenish, condition of the pith may extend far below ground and occasionally to the end of the stem while upward it generally extends to the succulent stem tips. Plants longer affected have the greenish color replaced by a light brown that is scattered irregularly through the pith and is particularly prominent in the ring of woody substance outside The lower leaves upon such plants often become yellowish and their bases soft—almost slimy.

Under the compound microscope the diseased portions of the plant showed the presence of large numbers of bacteria while all traces of any of the filamentous fungi common to rusts, smuts, mildews, moulds, and many of the blights were invariably absent in freshly gathered stems that were unmistakably diseased. That bacteria are the cause of the trouble now prevalant in so many tomato fields of the South requires for its establishment prolonged and painstaking experiments in both the laboratory and the field, both of which were impossible at the time of the visit. All that can be done in this report is to put on record the observations in the field, the tests made indoors and the more extensive examinations carried out, so far as suitable material was present, in my laboratory after returning from the south.

After being reasonably assured that the cause of the blight was a minute micro-organism, a large series of attempted inoculations was made, but from lack of proper means and owing particularly to the dry hot weather prevailing during the time no decisive results were obtained upon the growing plants in the field; while in green fruits the disease was sometimes seemingly transmitted, there was nothing warranting a conclusion that the disease had been communicated to the living plant by means of the virus employed.

A BLIGHT OF POTATOES.

While these experiments were in progress visits were made to some potato fields, the suspicion having arisen that the tomato blight was akin to the bacterial disease now quite well known to be practically destructive to the potato crop in some parts of the country. Upon a field owned by Mr. Rupel, it was found that fully one-fifth of the crop was destroyed with a bacterial decay, and the vines generally were badly blighted. According to Mr. Earle, this trouble with potatoes has been more or less prevalent in the vicinity of Ocean Springs for the past three years, the length of time he has lived there, and for aught we know to the contrary may have prevailed to the same extent for a generation or more.

In this connection it is only proper to briefly outline the appearance of the affected potato plants. The blight may be recognized by the premature dying of the vines and, when the trouble is violent, plants exhibit a wilting characteristic of the tomato blight previously mentioned. Below ground the stem is more or less darkened, in patches brown, and occasionally almost black. The old "seed" potato is a soft rotten mass, and the few new potatoes usually small and decayed, invariably at the stem end and almost always at the eye, appearing at first "watery" and afterward brown. It is an interesting fact to be stated in passing that the earth adheres very closely to the surface of the decaying portions. It seems evident from the extended study of these diseased potato plants, hundreds being examined, that the rot passes from the main stem to the tubers, and probably comes originally from the "bud". Often a lateral underground branch including its minute potatoes, as large as peas, is entirely softened. Upon making halving sections of the tubers it is seen that the most diseased portion is in a circle which includes the base of each eye. This portion is a soft, growing layer, rich in nitrogenous substances, and furnishes the avenue through which the disease spreads from one eye to another. From this decayed tract a milky juice quickly accumulates upon the section that is made up very largely of bacteria and contains no other form of fungus.

Without any further evidence than that coming from a thorough field inspection and a microscopic examination of the diseased tubers it would not be difficult to hold a strong opinion that the trouble was due to bacterial germs. Its method of propagation from year to year seems well provided for in the "seed" that is used, for should it contain only a very small amount of the virus not easily detected, the means are supplied by the habit of growth for the communication of the disease to all parts of the plant, young tubers in particular.

INOCULATION.

Having found the bacterial disease of the potato in serious abundance in the neighborhood of the blighted tomato fields, and knowing that the potato and tomato are nearly related plants of

the same family, it was a natural inference that the blight of the two crops sustained a more than accidental relation in the vicinity of Ocean Springs.

Inoculations were therefore attempted between the potato and tomato similar to those with diseased tomato virus upon healthy plants, but the extremely unfavorable conditions in the one case prevailed for all, and results that might otherwise have been hoped for were not forthcoming. All tomato plants were at that time of full size and did not admit of treatment under bell jars, even if such aid to study had been at hand. A large number of inoculations, however, were made indoors by taking sections of healthy stems and keeping them in a moist chamber made by inverting one soup plate over another, the specimens being raised above the water kept in the bottom of the lower plate. These tests were all made in sets of five with an equal number of checks. Thus, there were five slices of small tomato inoculated with virus and five with similar scored or pricked places, but without virus added. Five were also inoculated with bacteria from a potato and five were not. Five three-inch pieces of tomato stems were inoculated with tomato virus, with checks; five with potato virus and checks. Potato stems were treated in the same manner, using tomato virus. The virus under these favorable conditions invariably grew, while the checks nearly always failed to show any indication of the disease. The potato virus was often the most active, but not always so. This was repeated with substantially the same results, only the milky ooze of the diseased potato being used. Only one of the ten checks rotted. The tomato virus worked fully as well as that of the potato.

Sliced healthy potato tubers were inoculated with tomato stem virus and a rapid decay followed from the center of each infection. One check softened but in this case the slice got tipped into the water below. Sliced tomatos inoculated with potato virus gave rottenness in twenty hours while the checks remained sound. The same plate contained slices inoculated with tomato virus in which all "took", but less rapidly than the other set.

As these tests were made and results obtained in twenty-four hours, they were repeated in great numbers until there was

no possible doubt about the tomato, potato, and melon tissue, whether of stem, fruit or tuber, being susceptible to decay from the same germ, and as only bacteria appeared first in these inoculations it seems safe to conclude that there is a bacterium common to the three kinds of plants and to which may be ascribed the cause of the trouble now being experienced in the Southern States.

As there had been complaint of a melon blight, stems of those plants were treated in a manner parallel to those of the tomato and potato and they decayed equally well with the other two.

TESTS WITH SEEDLINGS.

The next point of attack in the problem in hand was to grow seedlings under varying conditions, and the following set of six seed boxes was sown May 8th. In No. 1 the tomato seed was sown in earth with which a considerable quantity of the chopped diseased tomato stems were mixed. Number 2 was sown in the ordinary way. Number 3 had the seed soaked for five hours in the juice of diseased stems and No. 4 was sown without treatment like No. 2, but the young plants were spayed from time to time with bacterial juice. No. 5 was the same as No. 1, with the chopped tomato stems replaced with cut diseased potato. No. 6 was the same as No. 2, a check. These boxes were left in charge of Mr. Earle who faithfully watched and watered them. On May 26th he wrote that the plants each had the rough leaves and no real difference was manifest in the lots. At about the same time a package of seedlings was sent me containing a half dozen plants from each box upon which the following notes were made on the day of their arrival: Only two lots came through in good shape and in three the stems were firm and healthy and only the foliage, which was extremely tender, was withered and slightly decayed. These were the untreated plants. The next best were the two lots in which the plants were equally and badly decayed, the stems being so soft that it was impossible to lift a plant with the fingers: These were numbers 1 and 5; those planted with the diseased tomato stems and the diseased potato tubers respectively. The other two lots were so far gone as to be found with diffi-

culty, the worst being No. 3 where the seed had been soaked in tomato virus and the other (No. 4) sprayed with the bacterial decoction.

It would seem from this that, while the young growing plants may not have showed any signs of the disease, the germs were in some and not in the others, and under the favoring conditions for decay furnished by the package in transit, those which were inoculated were overcome, and the others were not.

On June 8th after ten plants from each of the boxes had been set in the field for a week Mr. Earle made the following report.

No. 1.	Three alive	(chopped diseased tomatoes.)
No. 2.	Eight alive,	(no treatment.)
No. 3.	Six alive,	(seed soaked in water.)
No. 4.	Three alive,	(seedlings sprayed.)
No. 5.	Three alive,	(chopped rotten potatoes.)
No. 6.	One alive	(no treatment.)

By this it is seen that one untreated is highest but the other the lowest in living plants. The general appearance of the boxes at the time of setting out showed that numbers 2 and 6 were best and number 1 decidedly poorest.

On July 5th Mr. Earle wrote, "Of our experimental plants I find that out of the sixty set but nine are still alive. Five of these belong to lot No. 2, three to No. 3, and one to No. 4."

It is seen that all plants started with diseased tomato chips or rotting potatoes had failed, and over half that survived were from an untreated box.

The same box experiments were repeated at my labratory, the diseased tomato skins and the decayed potatoes having been obtained by express from an infested field at Ocean Springs, through the kindness of Mr. Earle. The following is a tabulated statement of the results as obtained from the duplicate box experiments, so far as they could under the circumstances be said to be duplicates:

No. 1—Plants came up poorly.
No. 2—Seeds came up well and plants grew finely.
No. 3—Plants did only fairly well.
No. 4—About as No. 3.
No. 5—Only a few plants came up.
No. 6—Was omitted as but five boxes could be placed in the window and it would have been a duplicate of No. 2.

At the end of a month there were only a few second-rate

plants in boxes 1 and 5, No. 2 continued to thrive and was closely followed by No. 4. It should be said that, due to the long distance from supplies, the experiment of spraying with disease germs was not satisfactory, and should be taken as an incomplete test. Box 3 contained many good plants and, so far as these experiments go, it seemed evident that the disease was communicated from blighted tomato stems in the one case and from the rotten potatoes in the other, and to a degree that was ruinous to the seedlings in both cases.

BACTERIAL MELON BLIGHT.

This portion of the paper was presented at the Washington meeting of the American Association for the Advancement of Science and afterward published in "Botanical Gazette" for November 1891, page 303.

Early in July there were many complaints throughout the country that the melon, squash, and cucumber vines were either not doing well or were dying from some unknown cause. The first specimens to arrive were from Bangor, Me., followed by others from the central part of New Jersey, a locality famous for the production of cucurbitaceous fruits.

The attacked vines vary somewhat in their appearance, but generally there is a decay of the stem in proximity to the root, and that the whole plant wilts and fails to grow. Sometimes one or more leaves will fall to the ground and rot away before the balance of the plant is seemingly affected. This is particularly true of cantaloups, while in the case of cucumbers the fruit may be the first to show trouble. Here the half grown cucumber exhibits from 1 to a dozen or more specks looking like water cores; which increase in size, until the whole of the fruit becomes a rotten mass, the firm skin still holding the watery interior in shape.

A microscopic examination of the decaying stems, leaves, and fruit showed that the decomposing tissues were teeming with bacteria. This was to be expected, but it remained to prove that these germs could be the primary agent in the decay. Inoculations of healthy fruits were made in the usual way by means of sterilized platinum wire, taking the germs from the centre of freshly decaying cucumbers. It was found that with no other fungus present these germs were abundantly able to introduce a rapid decay into cucumbers, melons, and squashes. Cucumbers seem to be the favorite, and in them the decay is the most rapid. It will run from one end to the other through the succulent center of

a four inch fruit in a single day. From the placentæ the rot spreads towards the surface until all is a noisome pulp enclosed by the skin which may remain unbroken if the inoculation has been made at the stem end.

The next step in the study was the application of these germs to healthy plants in the field. This was done by means of a flamed glass tube one end of which had been drawn out into a long point. By means of this, the germs in the liquid, after being drawn into the tube, could be introduced into any part of the plant, even into the woody base of squash vines. When the inoculation was made near the end of the vine, the latter rotted away in from three to four days and when nearer the base a longer time was required, but in all more or less rapidly, depending upon the tissues infected. In old stems the decay was almost entirely internal, and did not show much till the disease had spread through the pith to some distant soft parts. A medicine dropper was employed to place a charge in the middle of several petioles of large squash leaves. Upon the next visit, twenty-hours later, all such leaves had fallen to the ground, and the portions of the petioles below the point of inoculation, six or more inches in some cases, were thoroughly decayed. In short the bacterial disease was found in the cucumber and afterwards propagated from fruit to fruit in the labratory, as also upon cut stems and petioles, is readily transmitted to vigorous living vines of the cucumber and squash in the field.

Sixteen seeds of summer crooked squash were divided into two equal lots, and each set of eight planted in a flower pot under a bell jar and in every way treated alike, except that the soil of one pot was watered at the beginning of the experiment with the juice of a cucumber which had decayed with bacteria. The eight seeds not receiving the bacterial liquid germinated quickly, producing large, deep green plants, while in the other pot only two plants appeared above ground, and they were dwarfed, of a sickly, yellow color, and did not continue to grow. These two plants were quite close to the side of the pot and did not receive a full wetting by the bacterial water. The remaining six seeds when removed from the soil were decayed and noisome.

Eight seeds were next placed upon blotting paper, moistened with distilled water, and kept covered in a small artist's saucer, while a duplicate set were similarly placed, but wet with a solution containing bacteria from a decaying cucumber. Here again the untreated seeds all grew with usual vigor, while those in contact with the bacterial germs failed to germinate and soon decayed.

The pure virus was next introduced into the growing stems and green fruit of the tomato, and in both cases quickly produced a decay that caused the stems to fall and the fruit to become a

watery mass enclosed by the skin, similar to the cucumber from which the bacteria were taken for inoculation. At the time of the experiments some boxes of young tomato plants were close at hand, and into the centre of one of them a decaying cucnmber was placed. In six hours some of the stems of tomato plants six inches in height had rotted off close to the ground, where the liquid from the decaying fruit had come in contact with the young plants. In ten hours all the plants in the vicinity were destroyed. Drops of the virus placed in the leaf and other plants quickly induced decay and death of the parts.

The virus from a cucumber was also used upon potato vines in the same manner as upon squashes, but both the extreme age of the plants and the dry weather may have been unfavorable, as the decay was slow and comparatively harmless. Healthy tubers, however, when inoculated with the cucumber bacteria rotted with that rapidity characteristic of the bacterial decay of the potato. In all cases the tubers became of a pasty softness, and gave off a most unpleasant odor. This decaying substanee when taken back to fresh fruit of the cucumber continued to produce rapid decay.

These results seem to corroborate those that were previously obtained in Mississippi and assist materially in accounting for the failure of melons after tomatoes or vice versa upon fields where the preceeding crop has been blighted.

While it is yet too soon to draw fully substantiated conclusions the following are offered as being those that the investigation in its present fragmentary condition now suggest, but subject to modification in the light of further results from field observations and laboratory experiments.

CONCLUSIONS.

1. The Southern Tomato Blight seems to be due to a bacterial germ.

2. The infested plants first show a wilting, and then lose their green color and die.

3. As far as observations show, the blight is not limited to any kind of soil, situation, or exposure but may be found any where.

4. It seems probable that the plants may be attacked being set in the field as well as afterward.

5. There is a Potato Blight due to a bacteria that is communicable to the tomato, as repeated inoculation show, and the disease of the two plants seems to be the same.

6. A blight of melons and cucurbits generally is of bacterial origin, and seems to be the same as the blight of the tomato and potato.

7. If the above statements be true, it follows that a soil may become so contaminated with bacteria from any one of the three crops as to make it unfit for either of the other two. Repetition of the same crop, of course is not desirable.

8. The potato is the best adapted from the nature of its "seed" to the dissemination of the blight, as it can be carried unobserved in the potatoes used in planting, and with it special care should be taken.

9. As the Bordeaux mixture has proved effective for the bacterial disease of the potato, spraying with this compound is recommended for all three crops where fear from blight is entertained.

10. Care should be taken to burn the diseased plants when found, and also all litter in the field at harvest time.

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Grasses and Forage Plants.

S. M. TRACY.

AGRICULTURAL COLLEGE, MISS.

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GRASSES AND FORAGE PLANTS.

When the Agricultural College of Mississippi was organized in 1880, one of the first lines of work undertaken was the cultivation of grasses and forage plants, both for the production of hay as a part of good farming, and for the restoration of the worn out and exhausted clay hills which then formed a large part of the College farm. When the Experiment Station was established in 1888 one of the first orders passed by the Board of Trustees was for an investigation of the comparative values of different plants for the double purpose of providing hay and pasture, and for improving the condition of the soil.

As cotton is now the principal crop grown in the state, and will doubtless continue to be so for many years to come, the effect which a forage crop has on the soil has received fully as much attention as has the value of the hay or pasture which may be secured. The part of the plant which is above the soil is needed as food for stock, but in many cases that part below the surface of the ground is of still greater value as food for future crops.

It is now a well established fact that many Leguminous plants, including the clovers, cow peas, melilotus, lespedeza, etc. have the power to absorb nitrogen from the air, a power which is possessed by the true grasses to a very slight extent, if at all; and it has been among such plants that we have endeavored to find those which are of the greatest value in restoring and retaining fertility. Acting upon these ideas, we have procured seed of more than three hundred species, many of them being from northern India, Australia, Russia, and other foreign countries. We also secured seeds of a large number of species from the arid regions in the southwest, and have taken special pains to secure seed of such native species as seem to be of value. Many of these were received in very small quantities, and we have been obliged to grow two or three crops before securing enough seed for field tests, but thirty-nine kinds have been planted on areas of from one to three acres each, and several upon much larger fields.

With so many species, coming as they did from all parts of the world, it was not expected that all, or even many of them, would prove valuable for cultivation under the peculiar climatic

and soil conditions which exist here, where the growing season for different plants extends nearly through the year, and where protracted summer drouths and excessive winter rains make it necessary that hay and pasture fields should be able to resist great atmospheric extremes A large majority of the native forage plants in this region commence their growth late in the spring, but from about the first of April to December the pastures are abundant, and certain kinds of hay may be cut at any time from June to November. The great desideratum for this region is a plant which will make a fair growth for pasture during the cool and rainy months of winter, and one which will leave the soil in a better condition at the close of each year.

Whatever may be used for this purpose should be a perennial, so that fields need not be reseeded often; it should be adapted to great differences in soils, the roots should be able to endure continued drouth, and the forage must be relished by all kinds of stock. We have no plants which continue in active growth throughout the year, so that for a winter pasture we are obliged to look for one which will not be choked out and destroyed by other plants which occupy the ground during the summer months, and for a permanent pasture or meadow we must look for a mixture in which the stronger will not crowd out the weaker, and which will produce successive growths throughout the season.

Among those species which have succeeded best have been the following:

JAPANESE RYE *(Agropyrum japonicum).*—In its general habit this is much like Rescue-grass *(Bromus unioloides),* but does not grow as large and the heads are somewhat bearded. It will grow later in the season, however, and propagates itself more readily from seeds on unplowed land, and is perennial. It is eaten readily by all kinds of stock, and appears to be a valuable species for mixing with other pasture grasses.

RED TOP, *(Agrostis vulgaris).*—On low and damp soils this is a valuable grass, as it remains in fair condition throughout the winter, furnishes excellent grazing, and is not easily killed by overflows, even when covered with water for two or three weeks at a time. We have no better grass for marshy lands and seepy hill-sides, and it has done moderately well where the ground was quite dry. During the first season after sowing, it makes but little show, but becomes stronger and more dense with age, and maintains itself well against weeds and other grasses. It will produce one good cutting of hay and usually a second lighter one but its chief value is for winter and early spring pasture. In seeding land to this grass we have found it well to add one bush-

el per acre of either Italian or perennial ray grass, which makes a quick and early growth, but which will almost wholly disappear after the first season, when the red top will become stronger and occupy the ground more fully. We have found it one of the best grasses to use in stopping washes. By building a bank across a ditch and throwing a handful of the seed on it, the grass quickly covers the bank, catches and holds the soil washed in from above, and soon fills the ditch.

AUSTRALIAN BLUEGRASS,(*Andropogon crianthoides*).—This is a perennial species from Australia which has been cultivated in a few localities for a number of years, and advertised to a considerable extent, but its growth has not been very satisfactory here. It is so tender that it barely lives through the winter in this latitude, and starts into growth late in the spring; though it makes an excellent growth during summer, and will give two good cuttings of fine, tender, and nutritous hay. The leaves are killed by a moderate frost, and it fails to hold the ground against the encroachment of other grasses. Several other species of Andropogon from Australia and from India have also been tested, but this appears to be the best of the genus, and the only foreign one which makes any promise of final success.

SMOOTH BROME, (*Bromus inermis*).—This is nearly related to the Rescue grass, but endures the summer heat and drouth much better, and grows on much poorer and harder soil. It produces a great amount of long and tender leaves near the ground, while the culms are rather slender and are not produced in any very great abundance, so that it is better fitted for grazing than for hay. It is one of the few species which remains green through the entire year and bears grazing well. One plot of this was sown three years ago, and so far, it has held the ground to the complete exclusion of all other grasses and weeds.

RESCUE GRASS, (*Bromus unioloides.*)—This is a winter grass which produces even more abundantly than does the Orchard grass, when sown on rich and not too heavy soil, but requires more care in its management. If sown in September or October it will usually make a heavy growth during the fall and is often ready to cut for hay as early as February, and may be cut once or twice more before June. It becomes weak and nearly disappears on approach of hot weather, and if it is desired to make the field a permanent meadow, should not be cut after April so that the last growth may ripen seed. With favorable rains the seed will germinate in September or October, and will then furnish abundant food during the winter. Sown with equal care it will give a better winter pasture than will either oats or rye, and in

the spring can be plowed under with equal advantage as a fertilizer. When properly handled it is one of our most valuable grasses, but unless it receives attention to secure it an opportunity for self-seeding it cannot be relied on to form a permanent sward.

INDIAN BEARDGRASS, (*Chrysopogon serrulatus*).—This is a perennial grass, the seed of which was received from India, and which is one of our most valuable importations Although nearly related to our native "broom-sedge," it starts into growth much earlier in the spring, produces a heavier growth of leaves, and will yield two cuttings of excellent hay besides a considerable amount of winter pasturage. It has been entirely free from any injury from cold and from all attacks of fungous diseases, and is spreading well by self-sown seeds. It grows four to five feet high, and more than one-half the weight of the hay is made of the leaves, the stalks being rather small. We have saved all the seed we could collect of this species, and have distributed it to the other stations for further trial.

BERMUDA GRASS (*Cynodon dactylon.*)—This grass is the most valuable species we have in the South and is too well known to need any description. It succeeds best on rich bottom lands and on the black prairie soil, where it will yield two cuttings in a season, making two to four tons of hay per acre. This hay is of the very best quality, being especially valuable for horses and mules. When once established in a field it is very difficult to eradicate, and this is a decided objection to its general cultivation. The best method we have found for destroying it is to plow the land very shallow as early in the fall as is possible. Plow again in November and sow oats. When the oat crop is removed sow thickly with peas which will smother the few plants which may have survived the oats.

ORCHARD GRASS, (*Dactylis glomerata.*)—This grass has given us a better winter growth on heavy clay soils, without attention, than has any other species which we have tested. It commences its growth with the first warm days of February, and if not pastured is ready to cut for hay in May, and will then afford excellent grazing until checked by the summer drouth. With the first fall rains it starts a new growth of leaves, making excellent fall pasture, and keeping fresh and green all winter. Its habit of growing in large clumps is against its use as a hay grass, but it bears grazing well, recovers quickly when cropped down, and makes its best growth during the cooler parts of the year.

TERRELL GRASS, (*Elymus virginicus.*)—This is another native perennial which has received little attention, but which is of con-

siderable value for winter pasture. It grows most abundantly along creek banks and on the borders of the woods, but will grow on almost any soil. Its best growth is made during the fall and winter months, and it is ready to cut in May, but the hay made from it is of rather poor quality. Although a perennial, it is best to take stock off the field sufficiently early to allow the the roots to become strong enough to stand the summer drouth. Mr. A. S. Yarbrough, of Como, Miss., who has grown it for many years, says: "It will stand heat and cold without injury, but it cannot stand pasturing in summer. It, and Japan Clover, are the only forage plants that we need and about the only ones that are worth growing. If sowed in September, on either plowed or pastured land, when the fall rains commence it will begin to grow and be from two to ten inches high by December 15th, after which it can be grazed in suitable weather through the winter and spring, when the land ought to be allowed to grow into Japan Clover or Bermuda, but never pastured during the summer." Experience with this grass at the Station indicates that, like the Rescue grass, it will be of considerable value under good management, but of little use when it fails to receive the proper attention.

TEOSINTE (*Euchlæna luxurians.*)—Although this has been before the public for many years, it has not attained the popularity which it deserves in the Southern States. It is a remarkably vigorous grower, reaching ten to twelve feet in height, with an unusually abundant supply of leaves and very slender stems which continue to grow until killed by frost. If cut when it reaches four to five feet in height it makes excellent hay and will produce a second crop fully as large. If left to grow until September or October it furnishes the very best of material for the silo, and a greater amount per acre than does either corn or sorghum, and we have found no other plant which is its equal for soiling purposes. Its season of growth is so long that it seldom matures seed north of latitude 30, but it ripened well last year at the Louisiana Station.

THE RAY GRASSES, (*Loliums*), have proved worthless for general use. They start readily from seed sown either in spring or fall, and make a vigorous growth until warm weather comes, after which they dwindle and disappear. We have succeeded in preserving plots more than one year only with the greatest care; and from five sowings in the field of the Italian, English and perennial varieties, we have nothing left excepting an occasional plant. None of them were able to stand our long summers, and cannot be recommended for Mississippi, except for sowing with more permanent varieties.

MUNRO GRASS, (*Panicum agrostoides*).—This grass has been in cultivation to some extent for fifteen years, and is valued highly wherever it is known. It requires a rich soil, on which it will grow three or four feet high, produces an unusual amount of leaves, has tender and succulent stems, and bears drouth well. Two crops of good, though rather coarse, hay can be cut during the summer, and for fall grazing it is the best of the family. It grows spontaneously in all the Southern States, usually being found along creek banks and on the borders of ponds, and seed can be saved with very little trouble.

PARA GRASS, (*Panicum barbinode*).—This is a perennial species which produces runners from ten to twenty feet in length, with an abundant supply of leaves and upright branches, and yielding an immense amount of forage. It does not mature seed in this latitude, but the roots live through the winter, and the new growth is ready to cut by June 1, and will yield a good cutting once in six weeks from that time until the end of the season, though it should not be cut after October 1, in order that it may have time to produce a crop of leaves to serve as a winter protection for the roots. This is of considerable value for the region near the coast, but is too tender to be recommended for localities subject to severe frosts. *Panicum spectabile*, from southern Europe, is very similar, but is rather coarser, and does not appear to be relished as well by stock, though it bears more cold.

SPREADING PANIC, (*Panicum proliferum*).—While this grass prefers a damp soil, it will also grow well on dry uplands, and as it makes its best growth in late summer when many other species have been killed by drouth, it is well worth cultivating. It continues to grow until killed by frost and, while rather coarse for hay, it makes excellent pasture, and cattle prefer it to almost any other grass during the summer.

CRAB-GRASS, (*Panicum sanguinale*).—This grass is found everywhere throughout the South in cultivated fields where it springs up after the cultivation has ceased for the season, and makes from one to two tons per acre of excellent hay. On land which was plowed in February we have cut four crops of about one ton each in a season. As its best growth is made in cultivated fields, and at a season when other forage is not abundant, it is of considerable value for grazing, and as the hay made from it is of very good quality and costs nothing but the cutting, it is highly prized by many planters, especially in the southern part of the State.

TEXAS MILLET, (*Panicum Texanum*).—This is much like the swamp panic, but larger and coarser in every way, and although an annual, it reseeds itself freely and holds the ground well against other grasses and weeds. Mr. Lea, of Texas, says:

> I consider it far superior to any grass that I ever saw for hay. It is a much more certain crop than millet, and cultivated with less labor, and all kinds of stock prefer it. In this region it is regarded, in the condition of well cured hay, as more nutritious than any other grass. It grows only in cultivated ground; it prospers best in the warmest season of the year; its luxurious growth subdues other grasses and some weeds.

With us it has not covered the ground as closely as has the swamp panic, and the stems are rather coarse for the best quality of hay. It also starts later in the spring, but bears drought equally well, and makes a heavier growth late in the season.

WATER GRASS, (*Paspalum dilatatum*).—This is a native species which is found in all parts of the State, though most abundant on the low black soils where there is an abundant supply of moisture. It is a perennial, and spreads slowly from the roots, but it seeds freely and when once started it will soon cover a field where the soil is suited to its growth. It grows from two to five feet high, and the stems are rather coarse for hay unless cut early, but it produces an immense amount of long and broad leaves which remain green during the entire winter, excepting after very heavy frosts. It bears the longest drouths without injury, bears grazing well, starts into growth early in the spring, and is one of our best pasture sorts. Its habit of growing in clumps is an objection to its use for hay, but it is an excellent variety for mixing with Red Top, as it grows best on the same character of soil, and largely increases the yield.

CARPET GRASS, (*Paspalum platycaule*).—This is a perennial species, which is indigenous to the southern part of the country, and which has spread northward until it is now found occasionally as far north as Booneville, Miss., but which is not abundant excepting in the southern half of the State. Its flat and spreading habit makes it of no value for hay, but it furnishes excellent grazing during nearly the entire winter. It grows best on rather low and sandy lands, and will bear closer grazing and more tramping than any other grass we have. It starts slowly from the seed, but when once established it grows rapidly, and a single plant will cover from ten to twenty square feet in a season. It roots at every joint like the Bermuda, but unlike that, it can be readily destroyed by cultivation. In favorable localities it occupies the ground to the exclusion of all other plants, even the bitter weed (*Helenium tenuifolium*) being unable to grow through the close sod. It starts slowly, but plants from seed sowed in March are now (January 15) eight feet in diameter and are unchecked by heavy frosts.

TIMOTHY, (*Phleum pratense*).—Makes a weak growth for a year or two, but soon succumbs to the encroachments of the more vigorous native grasses and weeds. The apparent reason for this is that the bulbs and roots become so weakened by the continued growth to which they are stimulated during the "warm spells" of winter that they are unable to withstand the strain of the summer heat and drouth.

TEXAS BLUE GRASS, (*Poa arachnifera*)—This is one of the most widely advertised grasses in the whole south, but its real value for general cultivation is still problematic. It is a perennial, and emphatically a winter-growing species. In favorable locations it begins its growth in October, and from November to May furnishes an abundance of luxurious pasturage. It matures its seed in April and by the first of June the leaves become dry and withered, and little is seen of it until October. It is difficult to propagate from the seed; but can be increased rapidly by means of suckers, which are produced in immense numbers. A rich loamy soil seems necessary for its successful growth, but in many places where the soil has appeared suitable, the growth has been disappointing. At the Station it has been planted in a dozen or more places and with varying results. On rich light soil it has made a compact, vigorous sod which fully covered the ground in six months after planting, and has furnished excellent grazing for years. Planted on equally good and well prepared ground, already set with Bermuda, it has lived, but has increased very little, and only occasional plants are to be seen during the late winter and spring months. On dry stiff clay it has nearly all died during the first season, and on some of the black prairie lands it has succeeded well. Its only value is for winter pasture.

KENTUCKY BLUE GRASS, (*Poa pratensis*).—This grass is not the uniform success here which it is further north, though in many places it is of considerable value. On low ground where the soil is dark colored and contains an abundance of lime, and on seepy hill-sides, we have seen a few excellent pastures of this grass which afforded good grazing in the late fall and winter months, but it is useless to sow it on the dry clay hills, and nowhere in this state does it make the smooth and even lawns or the broad meadows so often seen in Kentucky, and its chief value here is for mixing with Bermuda or some other grass for pasture. It shows but little during the first year from the seed, but if the soil is suitable it continues to improve for many years, and is a valuable addition to our permanent pastures for winter use. The cause of many of the failures with this grass in this state has been that it was sown on lands unsuited to its growth. This is especially true of the hills regions of the state, in which the soils

are so "spotted" and uneven that it is difficult to find an entire field which is adapted to the growth of any one kind of grass. When these uneven fields are seeded the blue grass will do well on those parts of the field suited to its growth, but it is so well liked that stock will leave other parts of the field for the blue grass portions and so over-pasture it until it is destroyed. No grass can thrive and spread under such treatment, and so it is often condemned as worthless because it is preferred by stock and is grazed so closely that it is not allowed to succeed.

In speaking of its growth on the lime lands, Col. W. B. Montgomery, the largest breeder of Jersey cattle in the south and who has given more attention to grass culture than has any other man in the state, says: "This soil and this grass were made the one for the other This white lime blue grass land once seeded, the work is done for generations, and, that far at least, the labor problem will be solved permanently. All of this lime belt will not grow blue grass successfully. All this close adhesive soil will. The blue grass will burn less and remain green longer in summer than on the richer black soils which have more organic matter, and which are more open and porous. The light loose lands in this lime belt, whether they are the white shell lime lands or the deep open black lands, are not blue grass lands, but every inch of the white lime land that is sticky—slick like soap when wet—and the same character of black prairie land—we claim that every inch of it is blue grass land. It will not grow to do any good on a clay soil. It will not prosper on the light shell prairie knolls. It will grow splendidly on the lime rock that comes out of cisterns after it has been exposed to the mellowing influences of air, water, and frost."

JOHNSON GRASS, (*Sorghum halepense*).—This is at the same time one of the most valuable grasses and one of the most troublesome pests to be found in the south. It is a perennial which is easily propagated either by seeds or roots. It makes its best growth on rich bottom lands, where it soon occupies the whole ground, and will give three cuttings of about two tons each when in good condition. The hay is of excellent quality and is relished by all kinds of stock. The thick and fleshy roots soon become interlaced and matted in the soil, so that at intervals of three or four years the yield of hay is materially decreased, and the ground should be broken and harrowed, after which the grass becomes as vigorous as when first planted. The planter who wishes to grow hay and nothing else will find this a valuable species. As it requires a light soil for its growth, it is of but little value for grazing, and little is seen of it the second season the land is pastured. The objections to its cultivation are the rapidity with

which it spreads to fields where it is not wanted, and the great difficulty with which it can be eradicated from fields where it has become established. It will soon almost disappear when the fields are pastured, but the roots remain alive and will again take possession of the field as soon as it is plowed. Instances are known where fifteen and even twenty years of continuous pasturing have failed to produce any appreciable effect on the vitality of the roots. When there are only occasional small patches of it found in a field, they can be destroyed by covering with salt to the depth of half an inch, but when it covers any considerable portion of a field, the only practicable method of killing it is weekly hoeings. On sandy soils it can be readily killed in this way in one year, but on heavy clay or black lands the work is more difficult, and will require a longer time. In any case the field should be constantly watched for plants which are almost sure to make their appearance from seeds washed in from adjoining fields or dropped by birds, cattle, or passing teams.

SORGHUMS, (*Sorghum vulgare, vars*).—A large number of varieties of sorghum have been grown, the best of which appears to be the "Kaffir Branching" variety which grows from ten to twelve feet high and branches very freely from the upper joints, single stalks often bearing as many as fifteen heads of seeds. If cut early it will have fewer heads, but has more green leaves, and the stalk is less dry and pithy than if cut late. This has been the best of the cultivated varieties, though the "Rural Branching" and the "Yellow Branching" have done nearly as well. The two latter varieties are almost identical and both are valuable, especially for soiling purposes, as they make a rank second growth after cutting, even late in the season. Neither grows more than six or seven feet high, and both have stalks which are large and coarse, but are usually well covered with leaves. While they are superior to the "Kaffir" sorghums for soiling, their total yield of both seed and forage is less.

There is a variety of sorghum commonly known as "Chicken Corn" which has become thoroughly naturlized in a few counties of eastern Mississippi and western Alabama, and which is a valuable addition to our hay-producing crops. In general appearance this sorghum is much like the ordinary broomcorn, though the heads are less spreading, and the stalks usually branch at several of the joints, so that each bears a number of heads. It is usually most abundant in corn fields, where it starts into growth late in the summer, after the crop has been laid by, but grows rapidly and in September the corn in many fields is entirely hidden and the fields appear as though planted with common sorghum. If cut before heading it makes excellent hay and, on rich

land, will produce a heavy second crop. If allowed to mature, the yield of seed is about the same per acre as is that of the ordinary cultivated varieties, and is worth about as much for stock feed. The seed can be gathered at an expense of ten cents per bushel, and many planters now make a business of saving it to use in the place of corn, though it is sometimes difficult to keep on account of the attacks of weevils.

The most serious objection to this grass is that it is not safe to allow cattle to break into a field where it is making a second growth late in the season. When eaten at that time it is often fatal, and sometimes so within a few minutes. It seems to affect only certain animals, or perhaps only certain plants produce the ill effect, as generally only a few animals in a herd are killed, and these are commonly found very near together. The plant is said to have been noticed here first about twenty years ago, and it is doubtless descended from some of the many varieties of sorghum which were brought to this country from China. The area which it now occupies is probably not more than two hundred miles in diameter, being confined mostly to the "black prairie" region, but it is spreading slowly, and will doubtless soon be found in other localities also.

BEGGAR WEED, (*Desmodium molle*).—This plant requires close attention to be of value, but when properly treated it has been one of our most profitable forage plants. The soil must be rich, and should be moist rather than dry; the ground must be well prepared, and planting postponed until there is no danger from heavy frosts. The plants grow rapidly and should be cut when not more than two and a half feet high as, if allowed to grow taller, the lower leaves drop and the stalk becomes too coarse for hay. It will give at least three cuttings in a season, and as the roots go very deep, it is a renovating rather than an exhausting crop. Cattle are very fond of it, but it bears grazing only moderately well, and does not reseed itself well on uncultivated land.

COW PEAS. (*Dolichos sinensis*).—It is often desirable to plow under some green crop when it is imposible to give up the land for the one or two years necessary to grow a crop of red clover or melilotus. In such cases we have no other plant which is as desirable as is the cow pea. It may be sown at almost any time during the summer, will grow on any soil, makes excellent hay or pasture, and the long deep roots bring a large amount of plant food from the subsoil and leave it near the surface where it is available for succeeding crops. One of its great merits is that it can be grown successfully under such varying circumstances,

and that when the seed is put into the ground with even reasonable care, a crop is the sure result. Many planters use the bunch varieties for planting between the rows of corn or cotton at the last plowing. When sown in this way they do not interfere with the growing crop, will give a fair yield of seed, and the decaying vines make a most excellent covering for the soil during the winter. By spring the roots and vines will be thoroughly decayed, and by reversing the beds so as to bring the rows of cotton this year on the rows where the peas grew last year, the crop is largely increased and no time is lost. When sown in this way they are difficult to gather for seed, but make the best of fall pasture, and the droppings from the cattle fully repay the loss of the vines.

When sown broadcast after oats, wheat or some other early crop, the running sorts make a heavy yield of hay which although somewhat difficult to cure, is of the very best quality. By growing such a crop, hay is made at a very small expense, the soil is shaded during the driest and hottest months, is left loose and mellow and in the best possible condition for any future crop. The roots penetrate the soil as deeply as do those of red clover, and this fact makes the crop an especially valuable one for heavy and seepy soils which need draining. When land is not in use otherwise for even two months during the summer or fall, it will always pay well to seed it to peas, as the seed which can be gathered will fully pay the cost of cultivation, and give the fertilizing value of the crop as a clear profit.

WINTER VETCH, (*Lathyrus hirsutus*).—There are two distinct varieties of Lathyrus, both of which are known in this country as "winter vetch". As one of these makes its best growth in winter and the other in summer, it seems better to adopt the French names of "winter" and "summer" vetch. The winter vetch is sown in September or October so that it may germinate with the fall rains and secure a root-hold before very cold weather. It will grow slowly for a few weeks, but about the first of January the roots are sufficiently developed so that the tops begin to grow rapidly, and by February the plants form a dense mat from one to two feet deep, and continue to grow until hot weather. The plants bear grazing well, and stock of all kinds eat the dry hay greedily. For the Gulf states this is one of the most valuable of the many species which are sold under the general name of "vetch", making a heavier growth, being eaten more freely, and reseeding itself more fully.

JAPAN CLOVER, (*Lespedeza striata*) was introduced, probably from Japan, about forty years ago, and has now become thoroughly naturalized as far north as the Ohio river. It is an-

nual, but when once introduced, it perpetuates itself without care, and will make a fair growth on the poorest and driest of clay hills. It starts rather late in the spring, making little show before June, but from that time on it grows rapidly and is eaten greedily by all kinds of stock, until killed by frost. On sterile soil its growth is flat and spreading, and it is fit only for pasture; but where the soil is of good quality it will grow from twenty to thirty inches in height, and yield from two to three tons per acre of hay, which is fully equal in value to the best clover hay, and is the most profitable hay which can be grown on thin soil for feeding to milch cows or for fattening purposes. The seed sells for from four to five dollars per bushel, and at that price the supply has never been equal to the demand. In a favorable season the yield of seed is about five bushels per acre, and the hay from which the seed has been threshed is worth about half as much as when cut for the hay alone. When the crop grows very tall so as to make a heavy crop of hay the yield of seed will be small and not worth the threshing, but when the plants are so scattering that they have room to branch widely, they will produce seed much more freely.

Although this is one of our most valuable hay and pasture plants, it is also one of the best for fertilizing purposes from the fact that it gathers large amounts of nitrogen, sends its roots deep into the soil, and will grow on soils too barren for the growth of most other plants. While, like most other plants belonging to the same family, it does best on a lime soil, it will also do well on the red clay hills where red clover or melilotus will fail.

BURR CLOVER, *(Medicago maculata).*—This plant is well worth cultivating in all of the Gulf states, and is growing in favor with those who have tested its merits. It is essentially a winter grower, being at its best from February to May, after which it ripens its seed and soon disappears. Stock which are unaccustomed to its use do not always like it at first, but soon learn to eat it, and many seem to prefer it to any other plant. It is an excellent plant for sowing on Bermuda land, as it matures its seed and dies at about the time the Bermuda starts into growth, and when the latter is killed by frost the clover soon takes its place. A mixture of these two plants comes nearer giving continuous pasture than does any other mixture which we have tested.

ALFALFA, *(Medicago sativa,)* has been grown with varying results On moderately rich and sandy soils it has proved very valuable for soiling purposes, furnishing cuttings as early as Feb-

ruary, with frequent successions until late in the summer. It also furnishes excellent winter pasture, and is a profitable crop on suitable soils. On heavy clay and dry hills its growth has been weak and unsatisfactory. If pastured on Alfalfa during the spring, cattle are seldom injured, but if not accustomed to it they are frequently attacked by bloat when turned into a field containing a rank growth, though it is probably no more dangerous in this regard than is red clover.

MELILOTUS, *(Melilotus alba)*.—This plant bears a close resemblance to alfalfa, but is larger and coarser in every way and is especially adapted to use on calcareous soils. It will make an excellent growth on any lime lands, even on the "rotten limestone" hills which are so barren that they will sustain no other plants, but is of almost no value on the red clays which contain but little lime. It is not generally liked by animals unaccustomed to its use, but it starts into growth very early in the spring when green forage is scarce, and if stock are turned on it at that time they very soon acquire a taste for it and eat it readily through the remainder of the season. When grown for hay, one and sometimes two crops can be cut in the fall after sowing in the spring, and during the next season two or three crops may be cut, after which it should be allowed to mature seed. Unless cut early, the stems become hard and woody, and in all cases care is necessary in handling in order to prevent the loss of leaves which drop from the stems very easily. Excellent hay can be made by sowing melilotus on lands which has been set in Johnson grass, the mixture seeming to improve the palatability of both. From land cultivated in this manner we have seen three cuttings, of about two tons each, made in a season.

As a restorative crop for yellow loam and white lime soils this plant has no superior, and for black prairie soils it has no equal. Most of the black prairie soils are still very rich in plant food and during the early part of the season cotton makes a rank growth on them and promises a heavy crop, but with the August and September drouths the bolls drop from the stalks, and the crop is far less than is expected from the rank growth of the stalk. The use of ordinary fertilizers seems to have very little effect on such soils, and the trouble with them appears to be in their mechanical condition rather than in want of plant food. Draining with tile has worked well where we have tri d it, but this is too expensive to be generally adopted, and we have found the growing of an occasional crop of melilotus to accomplish fully as good results.

The expense of seeding land to melitotus is less than for seeding oats, the crop is a profitable one either for hay or pas-

ture, and at the end of the second year the land is left in the best possible condition for any succeeding crop. The roots of the melilotus are very long, penetrating the soil to a depth of three or four feet, are quite large, and by their decay at the end of the second year leave the soil with innumerable minute holes which act as drains to carry off the surplus water, and loosen the soil so that the roots of other plants can go deeper and find more abundant supplies of food. Melilotus is one of the few plants which is able to draw its supply of nitrogen from the air and so, by its decay, it furnishes the most valuable and most expensive ingredient of commercial fertilizers free of cost, and in the best possible form.

The hay from this crop will not sell as well as that from lespedeza, but the crop is heavier, will furnish more pasture, and is by far the most valuable crop we have for a natural fertilizer.

In speaking of this crop Mr E. E. Dantzler, who has charge of two large plantations in Noxubee county Mississippi, writes as follows:

"I have had 5 years experience with melilotus. It should be planted in February but will do as late as 10th of April. There should be three-fourths of a bushel of seed per acre to secure a thick stand, but one-half bushel does very well. The land should be broken up broadcast and harrowed well before sowing. The plant seeds the second year, then the roots die—but not until it goes to seed. It has but one superior as a hay crop, which is our lespedeza, and it should be cut for hay when it is about 15 inches high, after that time it is too woody for good hay. I have moved it three times in one year, but generally twice.

I find it to be a better fertilizer than either peas or red clover I appreciate red clover very highly, but have abandoned it entirely since I found the advantages melilotus has over it both as a fertilizer and hay crop. I had a cut of poor land which would not produce more than 10 bushels of corn per acre. I sowed it down in melilotus, and then put corn back on it after running it in melilotus for two years, and gatherd 28 bushels per acre. Cotton land which made 600 lbs. cotton to the acre, makes now 1100 lbs. after two years in melilotus. I find it stands the drouth and cold better than any other clover. It is adapted to our black and worn out white lands. I don't think it will prove a success on our red post oak land, although I have not given it a fair trial."

In commenting on this letter in the "Stockman and Farmer," Gen. S. D. Lee says:

"Mr. Dantzler has had from 50 to 100 acres each of melilotus and red clover for five years. He is now dropping red clover, increasing acres in melilotus, as all the conditions for hay restoring fertility, drainage and more certain crop are on the side of melilotus. These facts are true of our prairie lands and are vouched for only for these lime lands. I regard melilotus as the "God send" for restoring fertility to our worn prairie lands, and in laying the road for changing from cotton to stock in our system of farming. I cannot too earnestly urge our prarie land owners to try it. My plan has been for five years, to keep one-third of my place in red clover, melilotus and lespedeza, and change crops so as to gradually get all my place in grass every four or five years."

MEXICAN CLOVER, (*Richardsonia scabra*).—This is an annual plant which is not a true clover, but takes its name from its habit of growth, which is similar to that of red clover It is a native of Mexico and Central America, but has become thoroughly naturalized along the Gulf Coast, and is often found on sandy lands as far north as Meridian and Jackson. A sandy soil seems essential to its growth and, like the crab-grass, it is much more abundant in cultivated fields than elsewhere, coming up after the crops are laid by, and making its best growth late in the season. While its roots do not go as deep as do those of the cow pea and other Leguminous plants, it makes such a rank growth that it is of considerable value as a fertilizer and for covering the ground late in the season and through the winter. When cut for hay, the yield is often two tons or more per acre, and the hay, which is usually mixed with more or less crab-grass, is of excellent quality. It is of little value for pasture.

CRIMSON CLOVER, (*Trifolium incarnatum*).—This has attracted great attention in the south during the past three or four years, but its true merits are still in doubt. So far, it has not given a good crop at this Station, though it is valued highly at the Carolina Station; and at the Florida Station has given one immense crop followed by two failures. Under favorable circumstances it makes a very vigorous winter growth and affords good grazing or soiling, but in many cases only a scattering stand is secured and the plants are weak and sickly. We cannot recommend it for cultivation in this state until we know more of its needs and value as a restorative crop.

RED CLOVER, (*Trifolium pratense*), is a universally recognized standard in estimating the values of all other crops when grown either for hay or as a green manure. For the latter purpose it is especially valuable, and is undoubtedly used more largely than are all other crops combined, and it is probable that we have no better fertilizer for soils adapted to its growth. Its growth in this state is quite variable, being a complete success in some localities and almost a failure in others. It has succeeded well in Coahoma and Bolivar counties and in some places in Prentiss county. Samples five feet in height have been sent to the Station from Noxubee county, and in 1890, thirty acres on the College farm yielded ninety tons of hay, and in 1891 forty-five acres yielded one hundred and forty tons. Where such yields can be made, it is one of the best crops which can be grown, but there are many parts of the state in which it has not been found profitable. It requires a soil which is rich and in fairly good condition to insure a "catch" of the seed, and on many soils where it makes a good start and yields two or three cuttings it soon becomes overrun with native grasses and is choked out. The "Timothy and Clover" mixture which is so popular in the north cannot be grown here with profit, as the timothy will not endure our long summers. For a permanent meadow, Bermuda has done better with clover than has any other grass, though the mixture is by no means satisfactory, and we know of no grass which can be recommended for sowing with it. On lime soils which are in good condition it will do well for one or two years, but it seldom pays for more than two seasons on the same ground. T. C. Billups, one of the best planters in Lowndes county, writes us that he has grown red clover with complete success for fifteen or twenty years on his black prairie land. His practice is to sow from fifty to one hundred acres every year, sowing from Feb. 15th to March 1, and using twelve and one-half pounds of seed per acre, and he seldom fails to secure a good stand. He allows the clover to grow three years, when the land is usually taken by weeds, which he then turns under with a four-horse plow sometime in September or October, and then beds the land for corn in January. He always follows the clover with corn, which yields from 25 to 30 bushels per acre, and he always has corn to sell He says, "I consider clover a perfect fertilizer for black prairie land. I have always sown clover on those lands which were most in need of rest, and those are now my most productive lands. I have never sown melilotus, as clover is good enough for me. On my thin post-oak lands I sow cow peas and lespedeza There is no question about it, green crops are our cheapest fertilizer."

HAIRY VETCH (*Vicia villosa*). The seed of this plant was first sown in October, 1888, and since then has given heavy annual crops on the same ground, although it has received no attention and the ground has not been plowed since the first sowing. In 1889 another field was sown and has given equally good results. This plant is an annual which bears a close resemblance to a very slender peavine, and which makes its entire growth during the cooler months. The seed germinate with the first autumn rains and, in a favorable season, will have the ground well covered by January 1. If the winter is cold, with frequent frosts; it may make but little growth before February, while if the weather is warm it will make fair grazing as early as December. If not pastured, the vines will reach a length of from ten to twelve feet in May, when the seed will ripen, and by July the plants will have disappeared. Stock eat the vines greedily, but should be taken off the field by the first of April to give the plants time to mature a crop of seed as, if even a moderate crop of seed is secured, the land on which they are grown will not need plowing or reseeding for the next season. We regard this as one of the most valuable plants we have for winter grazing.

As is stated on a previous page, it is impossible to find any one forage plant which continues in active growth through the year. For this reason a mixture of two or three kinds will usually prove to be better than will either one when planted alone, and when possible, one plant in the mixture should belong to the clover family. No one, two or three varieties will succeed best in all parts of the state, and the choice for each farm must depend on local conditions. Most of the true grasses are affected more by moisture than by other differences in the soil, while most of the clovers are affected more by the amount of lime. For general cultivation we regard Bermuda, lespedeza, melilotus, red clover, and Johnson grass as the best five species for this state, and value them in about the order in which they are named. For hay alone, Bermuda, lespedeza and Johnson grass are best, while for pastures we have found nothing better than Bermuda, orchard grass and burr clover for the lighter and more sandy soils of the pine woods region. Where a fertilizing crop is wanted for immediate effect, there is nothing equal to the cow pea, and when the land is to remain without cultivation for year or more, melilotus, red clover or lespedeza is the best crop that can be sown. If the land contains an excess of lime, melilotus is to be preferred, but if deficient in lime, and somewhat barren, lespedeza is the better crop. On lime soils that are in fair condition red clover will give excellent results as a fertilizer, and will also give two crops of hay which will be of more value than that from melilotus or lespedeza.

There are about two hundred species of grasses which are native to this state, and probably one-half the number can be found on every farm. Many of these are of great local value, and their growth should be encouraged wherever they promise to be permanent. Nearly all of the species which are now in general cultivation have come to us from the cooler climate of the northern states or of Europe, and when they fail it is usually on account of our long summer drouth. Bermuda, Johnson grass and lespedeza are almost the only ones which have come to us from countries having a similar climate to our own, and they are the ones which grow best here. That some of our native species will eventually take the place of the weaker sorts from colder regions, there is little doubt, and it is with a hope of calling the attention of our planters, cotton planters especially, to the importance of giving greater attention to the cultivation and improvement of our forage crops, that this bulletin is issued.

We cannot hope to grow profitable crops without the use of fertilizers in some form. Hay is a crop that finds a ready market at a price which makes it far more profitable than is cotton, and at the same time puts the soil in a much better condition for succeeding crops. Farming can be made profitable only when the soil is in a good condition and, as a recent writer says, "All the government aid in creation cannot relieve the planter until he begins to fertilize the impoverished soil."

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 21.

I. Insects Injurious to the Cabbage.

II. A New Method for Testing Milk.

III. Feeding for Milk and Butter.

AGRICULTURAL COLLEGE, MISS.

JUNE, 1892.

INSECTS INJURIOUS TO CABBAGE.

HOWARD EVARTS WEED.

The cabbage crop of the south is especially subject to damage by insects, the species described in this bulletin having been observed on the crop grown at the Station in 1891. The aim has been to make the description of each species concise, but at the same time to give sufficient of the characteristic appearance of each to enable those interested to readily recognize the different kinds attacking their cabbage, and the accompanying illustrations will aid much toward this end. Part of the illustrations have been obtained from the U. S. Department of Agriculture, through the kindness of Dr. Riley. Figs 1, 3-12, 16, 17-18, are after Riley; Fig. 13 after C. M. Weed; while Figs. 2, 14, 15, are original. A straight line at the side of an illustration indicates the natural length of the insect. The safe and economical destruction of these pests is of great practical importance and the remedies given are those which have proved of value in our hands.

THE IMPORTED CABBAGE WORM. *(Pieris rapæ*, Linn.*)*

This insect was imported from Europe, being first noticed in this country in Quebec in 1859. From that point its spread southward and westward was very rapid and now it is quite generally distributed throughout that portion of the United States lying east of the Rocky Mountains. This species has largely taken the place of its kindred native species *protodice.*

DESCRIPTION.—The adult form of this insect is the white butterfly so often seen flying here and there among the cabbages. The female butterfly, shown at *c* in Fig. 1, differs from the male by having two black spots upon the forewings, while the latter has but one. The butterfly is so well known that a more complete description is unnecessary and it can be readily recognized from the accompaning illustration. The chrysalis, shown at *b,* is about one-half

Fig. 1.

an inch in length and of a light green color. It is angular in outline and pointed at both ends. The larva, shown at *a*, is a dark green caterpillar and is nearly an inch in length when full grown. The body is covered with fine light hairs, those upon the back and sides having a light yellow tinge.

The yellow eggs are usually deposited singly, on the underside of the cabbage leaves, and, upon hatching, the young larvæ begin their work upon the leaves. Upon examination of infested cabbage plants the larvæ may be found on the inner leaves toward the head. In about two weeks the larvæ reach maturity, when they form the chrysalides, either on the underside of the outer leaves or upon boards or protected surfaces in the immediate vicinity, and in another week the butterflies come forth, thus completing the cycle of life. There are several broods of this insect during a season and, in this latitude, the first butterflies appear about the first of March and continue to appear until December. The winter is spent as a chrysalis.

PARASITES.—In Europe, where this insect is exceedingly common, there are many parasites which hold it in check. Its rapid distribution in this country is no doubt owing to the absence of its European parasites. It has several parasites here, however, and one of them, a hymenopterous insect, *Pteromalus puparum*, is especially abundant. Out of forty-six chrysalides collected in February from the walls of the Station forcing house, but nine hatched butterflies, the rest hatching large numbers of the parasite. This shows that the greater majority of these insects are parasitized, but there are still enough representatives hatched to continue the species.

The *Pteromalus puparum*, shown at Fig. 2, is a small, black, four-winged, fly-like insect which lays its eggs in the larvæ and chrysalides of the cabbage butterfly. A chrysalis containing the parasites can be readily distinguished by being more brittle and of a lighter color, while a chrysalis not parasitized is light green in color and has the abdomen of the body freely movable. The worm is also often destroyed by a bacterial disease which, when present in an infested field, kills off the caterpillars very rapidly.

Fig. 2.

THE SOUTHERN CABBAGE BUTTERFLY. *(Pieris protodice*, Boisd.)

This species is a native of this country and, until a few years ago, was the best known cabbage butterfly. Of late, however, the imported species has gradually pushed it to the wall, but it still occurs in small numbers throughout the southern and middle states.

DESCRIPTION.—The adult female of this insect is shown in Fig. 3, and the male in Fig. 4. As seen from the illustrations it differs much in markings from the imported species. The larva is readily distinguished from the *rapæ* larva by four yellowish stripes and dark spots along the body. When first hatched it is of a yellow color, becoming brown before the first moult, the yellow stripes appearing after this moult.

Fig. 3.

The life history and habits of this species are much the same as those of the imported cabbage worm, except that this species usually feeds only upon the cabbage, while the imported species feeds upon other cruciferous plants.

Fig. 4.

THE LARGE CABBAGE BUTTERFLY. *(Pieris monuste*, Linn.)

This is a larger species than the foregoing and is essentially a southern insect, which abounds throughout the southern states as well as in the West Indies and Surinam.

DESCRIPTION.—The mature form of this insect is represented at *c*, in Fig. 5. The upper surface of the front wings is white,

Fig. 5.

bordered with black, and the hind wings are white in the male, while the female has a black line on the middle of the front wings and a few triangular spots on the hind wings. The larva, shown at *a*, in Fig. 5, is about an inch in length, of a yellow color and has four longitudinal stripes. The body is covered with black spots and also bears many bristles. The chrysalis, shown at *b* is yellowish and has two spines on the middle of the body.

This species feeds upon a variety of plants besides the cabbage and, although not common, in some localities it occurs in large numbers.

THE CABBAGE PLUSIA. (*Plusia brassicæ*, Riley.)

This insect is exceedingly common in the southern states and feeds upon a variety of plants besides the cabbage, such as celery, cauliflower, lettuce, turnip, and tomato. Upon the cabbage

it is quite common, especially upon the young plants, and towards the close of the season, when the insect in all stages of larva, pupa, and imago can be found in an infested field.

DESCRIPTION.—The adult form of this insect is a moth, shown at *c* in Fig. 6, resembling the cut-worm moths very much. The body and hind wings are light brown while the front wings are darker, varigated, with a silver spot near the center. The outspread wings measure nearly one and one-half inches and the body three-fourths of an inch. The moth usually flies at twilight or in the night, but is occasionally seen about the cabbage plants on cloudy days. The brownish pupa, shown at *b*, is about one-half inch in length and is enclosed within a mass of silk. It may be found within the lower leaves which are folded over upon the lower side. The larva shown at *a*, measures an inch in length when full grown and is a "looper" as is shown in the illustration, with the central portion of the body raised. It is usually green with light stripes, though occasionally the stripes are wanting. The greenish-yellow eggs are deposited upon the upper or lower side of the leaves, either singly or in clusters. Upon hatching, the larvæ eat holes into the leaves, occasionally eating into the head. Their depredations are especially noticeable late in the season upon cabbages set out in September. The larvæ are three weeks attaining their full growth and the length of time spent in the pupal state is about two weeks. There are about six broods in a season, the first moths appearing late in March.

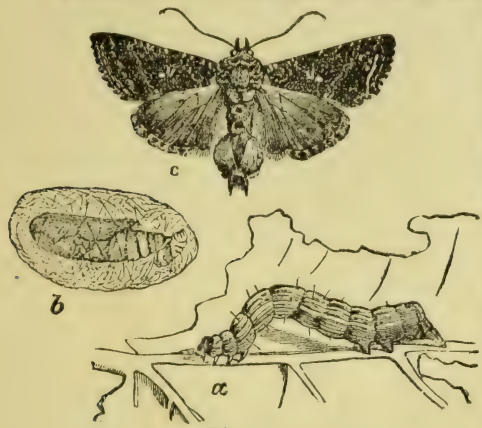

Fig. 6.

PARASITES.–Several ground beetles and a number of birds prey upon this insect and it is also destroyed by a bacterial disease. The most formidable parasite is *Copidosoma truncatellum*, a hymenopterous insect which is shown in Fig. 7. This parasite lays its eggs in the *Plusia* larvæ, upon which the larvæ of the parasite feed. An attacked *Plusia* larva has the characteristic appearance shown in Fig. 8, being pale yellow in color and very sluggish in its movements. By an actual count Dr. Riley states that 2,528 of these parasites emerged from a single *Plusia* larva. These parasites were very numerous at the Station last season, causing many of the *Plusia* larvæ to die before becoming pupæ.

Fig. 7.

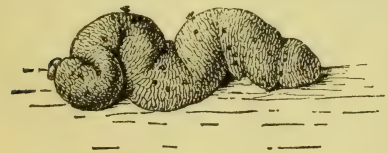

Fig. 8.

THE ZEBRA CABBAGE WORM. (*Mamestra picta*, Harris.)

The larva of this insect can be readily distinguished from the other cabbage worms by the brilliant yellow and black markings upon the body. This insect is quite common in some localities and was present in small numbers in the cabbage fields of the Station last season.

DESCRIPTION.—The imago of this insect is a brown moth, shown at *b*, in Fig. 9. The front wings are purple brown with a prominent spot in the center, fringed with white, while around the edges of the wings are small white spots. When first hatched the worms are nearly black and feed together upon a leaf, but as they become older they assume a pale green color and feed singly. When disturbed they curl up and drop to the ground. They become full grown in from two to three weeks, when they are nearly two inches in length with a wide longitudinal velvet-black stripe along the back, with two narrow yellow stripes on each side, between which occur fine yellow transverse lines. A full grown larva is shown at *a*. The larvæ pupate under about two inches of earth within a rude covering formed of earth held together by silken threads. In about two weeks the moths come forth, and in this latitude there are probably three broods in a season, the winter being spent in the pupa state. This insect is a very general feeder occurring upon asters, asparagus, honeysuckle, peas, and many other plants besides the cabbage.

Fig. 9.

THE CABBAGE EVERGESTIS. (*Evergestis rimosalis*, Gn.)

This insect is essentially a southern species, it being quite common throughout the south and extending as far north as Illinois. Like some of the other cabbage insects it is not content with eating the outer leaves, but bores into the head as well.

The moth which lays the eggs is shown at *c* in Fig. 10. The general color is ocher-yellow with the margins of the front wings darkened towards the tip, and the basal portion of the hind wings nearly transparent. The larva, shown at *a*, is quite slender measuring about three-fourths of a inch when full grown. The body is purplish-brown above and green beneath, with several white transverse

Fig. 10.

lines and a yellow longitudinal line along the side. The pupa, shown at *b*, is formed at the surface of the soil and is of a dark-brown color at the head and wing cases, with a lighter colored abdomen.

There are several broods in a season and the damage done by this species is quite marked, both owing to its being quite common, and its habit of boring into the heads. It feeds upon other Cruciferæ as well as the cabbage.

THE CABBAGE PLUTELLA. (*Plutella cruciferarum*, Zell.)

Owing to its small size this insect is apt to be overlooked and its larvæ might easily be mistakened for young larvæ of the white butterflies. It is well distributed throughout the eastern United States and, like most other insects infecting the cabbage, feeds upon other related plants, as the turnip.

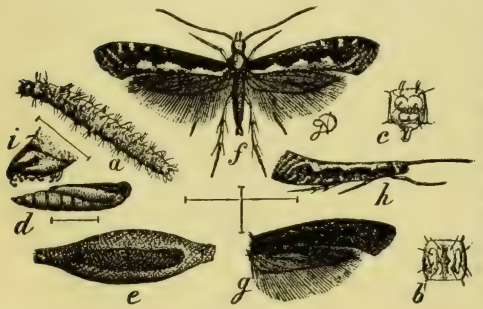

Fig. 11.

The larva, shown at *a*, in Fig. 11, is an active pale green worm measuring slightly over one-fourth inch in length. When disturbed it wriggles about, drops from the leaf and hangs suspended by a silken thread. The larva pupates within a small delicate cocoon shown at *e*, through which the pupa case can be readily seen. The cocoon and its pupa resemble somewhat those of the cabbage Plusia, but it is much smaller and more delicate. The small ash gray moth, shown at *f* and *h*, which resembles in form and size the well known Angoumois grain moth, hatches from the pupa in about two weeks. There are at least three, and probably more broods of this insect in a season, the moths being noticed the present season as early as February 28th. The larvæ feed mostly upon the outer leaves, doing but little damage to the heads especially if the latter are compact.

REMEDIES.—There are many successful remedies for the insects treated of in the foregoing pages, nearly all of which are very simple. The larvæ are all leaf feeders and can be reached

either by poisons to be taken into the system or by external irritants. As cabbages are used for food it is not advisable to apply poisons to the plants after they have begun to head, but they can be freely applied without danger before this time.

Paris green mixed with fifteen to twenty times its weight of flour and applied dry is an excellent application for the plants when in the cold-frame or a short time after they have been set in the field. It can also be applied to advantage in water, a teaspoonful to the pail, by means of a knapsack pump or hand force pump. Hot water is a good application for the cabbage worms. It can be applied quite hot without injury to the plants but will kill the larvæ with which it comes in contact.

Pyrethrum applied in the same manner as described for Paris green is a very simple remedy. This substance consists of the powdered leaves and flowers of the pyrethrum plant and can be obtained at the drug stores under the name of Persian or Dalamatian Insect Powder at a cost of about thirty-five cents a pound; while that grown in California costs about seventy-five cents a pound, and is of a better quality. The Pyrethrum is not poisonous, but kills by closing the breathing pores of the skin, and hence makes an efficient yet a harmless insecticide, especially valuable against cabbage worms.

Kerosene emulsion is an excellent remedy for all cabbage insects, but it is not best to apply it to plants which have formed heads, owing to danger of tainting. The emulsion is best applied in the form of a spray by means of a knapsack pump. It should be applied directly to the insects as it kills by irritation and not by poisoning.

Various forms of spraying apparatus are described in Bulletin 14, copies of which will be sent to those desiring it.

CABBAGE CUT-WORMS.

When cabbage plants are first set out in the field from the cold-frame they are liable to attack from various cut-worms which cut off the stems at the surface of the soil. They are so well known that a description of them is unnecessary. Their mature forms are the brown moths so common about lights.

The eggs of most cut-worm moths are deposited upon trees and shrubs and, upon hatching, the larvæ descend to the ground

in search of food. They feed principally upon grass when young. Upon the approach of winter they are nearly full grown and hybernate in grass, under boards, logs, and the like, and in the early spring come forth in search of food. They then feed upon a variety of plants, biting off the stems and feeding upon the leaves.

A common cut-worm, the dark-sided one, (*Carneades messoria*, Harris,) is shown in Fig. 12, *a* representing the larva and *b* the imago.

REMEDIES.—A common remedy consists in wrapping the young plants with paper when they are set out. Although this affords protection to the plants, a more recent remedy—that of poisoning the larvæ by means of bait traps—is much better. Bunches of freshly mown grass or clover are dipped into water into which has been mixed a small amount of Paris green, and these are placed about in different parts of the cabbage field. The cut-worms will gather under these and eat of the poisoned grass, and the dead larvæ may be found under about an inch of soil where these poisoned bunches have been placed. This is an efficient remedy, as a thorough trial will readily prove.

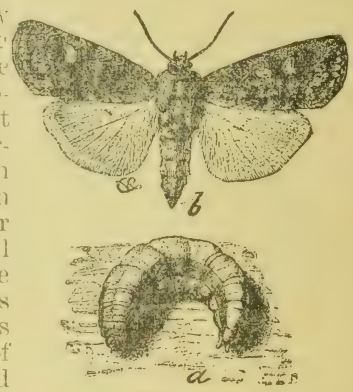

Fig. 12.

THE CABBAGE APHIS. (*Aphis brassicæ*, Linn.)

The cabbage aphis has been known in this country since 1791 and was probably brought from Europe soon after its host plant. It is well distributed throughout the United States and this season is especially abundant upon the cabbages at the Station grounds.

DESCRIPTION.—The cabbage aphis is a small greenish insect with a white mealy excretion covering the body. They are found either singly or in clusters on the underside of the leaves, or near the center of the forming head.

The form most commonly seen is the wingless form which gives birth throughout the season to living young. Besides this

form there is also the winged viviperous female, the apterous oviperous female, shown at *c*, in Fig. 13, and the winged male, shown at *a*. Throughout the season only the wingless and winged females are found, which, from time to time, give birth to living young. The increase of the aphides is very rapid, so much so that a single female may become the progenitor of many million lice during a season. Occasionally winged females are produced which may migrate to other fields. In autumn true males and females are produced and, after pairing, the winter eggs are laid upon the old cabbage leaves. However, if a suitable food plant is obtained the viviperous females will continue throughout the winter. On the Station grounds the past winter the aphides were to be found upon growing cabbage plants at all times. Young plants were set out early in December and the aphides soon made their appearance upon them and survived the winter although the thermometer registered as low as fifteen degrees Fah. The aphis feeds upon a variety of plants such as radish, mustard, and turnip, as well as upon the cabbage.

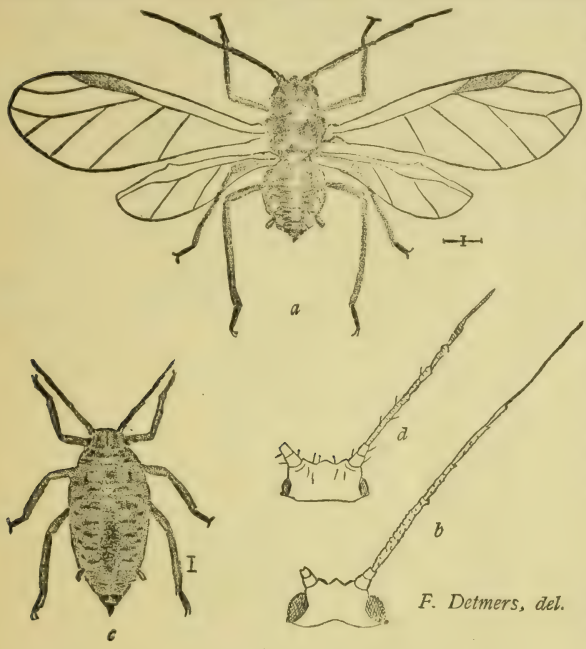

Fig. 13.

PARASITES AND REMEDIES.—There are many parasites which prey upon this insect and tend to hold it in check to a very large extent. The most common at the Station this season are the larvæ of a fly belonging to the genus *Syrphus*, and a small hymenopterous insect *Trioxys piceus*, Cress., the latter being especially common. The Syrphus larvæ are footless grubs about one-third of an inch in length. The ventral surface of the body is flat and

the body tapers from behind forward. These larvæ destroy large numbers of the plant lice by inserting their mouth parts into the bodies of the lice and extracting their life blood. The other parasite is a small fly-like insect shown in Fig. 14, which can be often seen among the cabbage aphides. This parasite lays its eggs in the bodies of the plant-lice and the larvæ hatching from them feed upon the aphides. In this manner Nature checks a too great increase of the aphides.

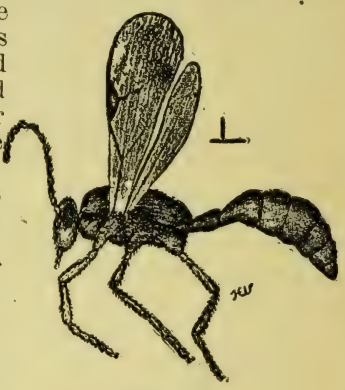

Fig. 14.

The lady-beetles are of great importance in keeping the aphides in check, as their food consists largely of plant-lice. A common form of this is the Convergens beetle, shown in Fig. 15. This beetle was found to feed upon the cabbage leaves to some extent last season but it is probable that this habit is only developed in the absence of the plant-lice.

Fig. 15.

The cabbage aphides are very easily destroyed by the application of any of the external irritant insecticides. Kerosene emulsion is the best for this purpose, and is best applied by means of a knapsack pump. It should be applied directly to the insects and kills by penetrating the skin. Pyrethrum in water, a tablespoonful to the pail, is very efficient, and tobacco decoction, made by boiling refuse tobacco in water, is also excellent.

THE HARLEQUIN CABBAGE BUG. (*Murgantia histrionica*, Hahn.)

This is by far the worst cabbage pest of the South, not because it is more numerous than the other cabbage insects, but because it is the hardest to destroy. It is quite generally distributed throughout the southern states and is rapidly spreading northward. It is probably a native of some southern country—Central America or Mexico—it being first noticed in this country in Texas in 1866.

DESCRIPTION.—The harlequin cabbage bug receives its common name from the reddish-yellow markings upon the body. The mature insect is a beautiful creature measuring two-fifths of an inch in length and one-third of an inch in breadth. The various stages of this insect are shown in Fig. 16, *f* and *g* representing the mature form. The general color of the insect is black but the thorax and wing cases bear yellowish-red markings while the under surface of the body is spotted with white and yellow. The pupa,

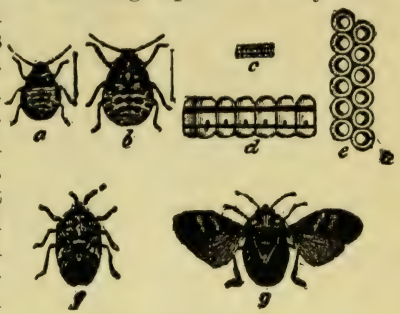

Fig. 16.

shown at *b*, differs from the mature form in being smaller, without wings and but four jointed antennæ while in the imago the latter are five jointed. The larva, shown at *a*, is quite small and slightly more yellow than the pupa. The eggs resemble a miniature barrel both in shape and markings. They are laid on the underside of the leaves in a double row as is shown at *e*. The usual number laid in a batch is twelve, but occasionally more than this number are laid, in which case they are arranged cylindrically—sometimes as many as twenty-seven together. The eggs are white with a slight greenish tinge and marked with black on the side and ends as shown at *d* and *e*.

LIFE HISTORY AND HABITS.—The harlequin cabbage bug spends the winter in the adult state, and the eggs for the first brood are laid the latter part of March upon radish and mustard plants. On the first warm days in March they congregate in large numbers upon these plants near the old cabbage fields. Egg laying commences the day following mating and extends over a period of at least ten days for each female. The length of time before the eggs hatch varies from two to eight days and as soon as hatched the young bugs begin their work of destruction by inserting their beaks and sucking the juice from the plant. They increase in size rapidly, shedding the skin several times during growth, and reach maturity in about three weeks after the eggs are laid. The length of time required for growth, however, varying from two to four weeks depending upon the temperature. Occasionally the eggs for the first brood are laid upon the cabbages, but as a rule cabbages are not attacked until the eggs for the second brood have hatched. The second brood

is much more numerous than the first and it is this brood that does the most damage. The insects make their appearance in large numbers just as the plants are beginning to head and, by their work in sucking the juices, cause the plants to become withered and useless. There are three or four broods in a season and the bugs are especially abundant upon fall cabbages.

REMEDIES.—There is but one efficient remedy for this insect, which is to destroy the brood which lives over winter when they congregate upon the mustard or radish plants. Here they can be destroyed very easily by the application of kerosene by means of a hand force pump or common watering bucket. If the insects are thus destroyed early in the season it will almost wholly prevent injury later. The insects fly but little and are thus not apt to come from a neighbor's field. Hand picking should be practiced upon the first appearance of the bugs upon the cabbages, and if any eggs are noticed these should also be picked off. The bugs and eggs are readily killed by placing them in kerosene. It is useless to try to kill these insects with Paris green or London purple or other insecticides which kill by being eaten, as they feed by suction, placing their beaks into the plant out of the reach of any poisons which may be applied to the surface. Kerosene emulsion is fairly successful in destroying the larval form. Diluted to its usual strength (that is, so that one-fifteenth part is kerosene), it is of no value in destroying the mature insect and when used with a greater proportion of kerosene the plant is damaged. It is thus seen that a substance extensively used for insects similar to the harlequin cabbage bug, is of but little value against this insect.

Our present crop of cabbage was put into the field early in March, and at the same time a row of radishes was planted through the middle of the patch. The radishes were well grown by the time the second brood of bugs had hatched, and nearly all the insects soon found their way to the radishes, where they were killed by spraying with kerosene. At this date, June 15, hardly a single bug is to be found in this patch, while cabbage planted in other parts of the grounds are badly infected.

THE CABBAGE MAGGOT. (*Anthomyia brassicæ*, Bouche.)

The mature form of this insect is a small two-winged fly somewhat smaller than the common house fly, and of a more uniform color, and is shown at Fig. 17. The flies make their appearance early in the season and deposit their eggs around the stem of the cabbage near the surface of the soil. The eggs hatch into maggots which penetrate and feed upon the stem just below the surface of the soil. The maggots, one of which is shown at *a*, are white, about one-fourth inch in length and reach maturity in about three weeks, when they form brown puparia as shown at *b*.

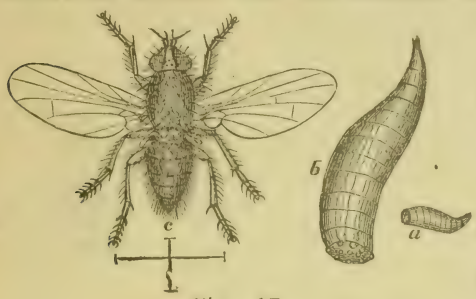

Fig. 17.

In this latitude there are several broods in a season, the insect passing the winter in either the larval, pupal, or imaginal states.

The damage done by this insect in some localities is quite marked, as by their work they retard growth and the plants do not head. If this condition of affairs exists the plants should be examined carefully about the roots to ascertain if the maggots are present. A dozen maggots may sometimes be found about and within one stem and roots, when they sometimes cause a swelling giving a similar appearance to that caused by a fungus producing the disease known as "Club root." The maggots feed also upon the turnip, and the radish maggot is probably the same species.

REMEDIES.—The remedies generally recommended for this pest consist of the application of lime, ashes, and the like around the stems. Recently, however, Prof. James Fletcher, Dominion Entomologist of Ottawa, Can. has shown the following to be a very efficient remedy: Two ounces of hellebore are steeped in three gallons of water, and by means of a small force pump the liquid is applied to the roots after first scraping away about two inches of earth. This should be applied as soon as the maggot attack is noticed and if an assistant scrapes away the dirt from each plant and replaces it as soon as treated, it will require but little labor to go over a large field. Kerosene emulsion applied as above is also effectual, and a knapsack pump will be found an excellent means for applying either, the stop-cock being turned as each plant is treated.

THE WAVY-STRIPED FLEA-BEETLE. (*Phyllotreta vittata*, Fab.)

This is the small shining black beetle so common upon most garden crops. It attacks cabbages especially and the mature insect does its damage by eating small pits into the leaves while the larvæ feed upon the roots. This insect is shown in Fig. 18, *a* representing the larva and *b* the imago. The larva is about one-fourth of an inch in length with a yellowish-white body and brown head. The beetle is one-tenth inch in length, oval, shining black excepting two broad yellow wavy lines upon the wing cases. The eggs are deposited by the female beetles upon the roots of many garden plants, upon which the young larvæ feed, often doing considerable damage. There are at least two broods a season, the beetles being most common in June and July. The larvæ of a similar species (*Phyllotreta zimmermanni*, Crotch), feed upon the leaves, but this species is not common here.

Fig. 18.

REMEDIES.—If refuse tobacco is applied to the plants and about the roots, it will act as a preventive against these pests, and a tobacco decoction made by boiling or soaking tobacco in water, is also a good remedy. If the larvæ are very numerous about the roots, kerosene emulsion, applied as described for the cabbage maggot, will prove efficient.

A New Method for Determining the Amount of Butter Fat in Milk.

L. G. PATTERSON.

Bulletin No. 15 of this Station, published in June, 1891, gives results of tests of the Beimling, Babcock, and Patrick methods for testing the amount of butter fat in milk, as compared with the very accurate "paper coil" gravimetric method of Adams. The results of the work published a year ago were summed up as follows:

"The Beimling method requires less time than does either of the others, but the scale on the bottles is not as easy to read, and no means are provided for keeping the fat in a melted condition.

The Babcock has the best bottles, but requires more time for its operation, and it is absolutely necessary to have the specific gravity of the acid 1.82.

The Patrick method is very convenient where a large number of tests are to be made, but it requires considerable time to heat the bath, and the bottles are very easily broken.

By referring to the above table it will be seen that all of the methods give fairly accurate results, but in the majority of the cases the methods of Beimling and Patrick tallied more nearly with the gravimetric, while the Babcock fell slightly low, but not enough so to injure the value or accuracy of the method for practical work."

Since the completion of the work published in Bulletin No. 15, we have been endeavoring to find some method by which we could secure results as nearly accurate as those of the Beimling, without the disadvantages attending the use of that method, and recognizing the excellence of the Beimling machine, we have used that and its accompanying bottles in our further work.

Any volumetric method should have the following characteristics to make it desirable for general use, viz:

1. Accuracy.
2. Simplicity.
3. Rapidity, enabling the operator to make any number of tests in a relatively short time.
4. Cheapness.

Any method which contains a constant source of error such as the charring of the fat column; or one which is unduly expensive in either time or in chemicals, is, to that extent, undesirable. After many trials, the method which we finally adopted, and which was used in making the determinations reported in this bulletin, is as follows:

APPARATUS. 1. A Beimling centrifugal machine.

2. Bottles for the same.
3. A chemical washing bottle.
4. Two pipettes, one holding 15cc, and the other graduated to measure 1½cc.
5. A small glass vessel with a lip, for pouring sulphuric acid.

REAGENTS. 1. Sulphuric acid, sp. gr. about 1.83.
2. Amyl alcohol (Fusel oil).
3. Hot water.

METHOD OF OPERATION.

Measure 15 cc of the milk to be tested into each of the bottles and then fill with sulphuric acid to within half an inch of the neck. Grasp each bottle by the neck and whirl between the fingers until all of the curd is dissolved, after which add 1½ cc of amyl alcohol and shake until the contents are well mixed. All of the bottles having been prepared in this way, are then placed in the centrifugal machine and whirled one minute, after which they are filled nearly to the top of the neck with hot water and again whirled for half a minute. The column of fat is then read from the bottom to the true surface and, by reference to the "ready reckoner" card the per cent of fat is obtained. If the fat should become hard in the neck of the bottle, a jet of hot water blown against it for a moment will be sufficient to melt it. The bottles should be washed out with hot water immediately after using, as they become difficult to clean after standing any great length of time. It makes but little difference whether the alcohol is added before or after adding the sulphuric acid.

The following table gives results of tests with the new method, as compared with those secured by the use of the ordinary Beimling and the gravimetric methods.

Number	Beimling	Gravimetric	New Method
1	3.91	3.86	3.83
2	3.22	3.23	3.22
3	2.96	2.99	3.13
4	2.79	2.83	2.79
5	3.22	3.27	3.22
6	2.96	2.87	3.05
7	3.87	3.80	3.87
8	3.52	3.44	3.52
9	3.22	3.35	3.22
10	3.22	3.17	3.17
11	2.92	2.88	2.88
12	3.31	3.33	3.31
13	3.91	3.87	3.87
14	3.17	3.17	3.13
15	3.22	3.14	3.22
16	3.27	3.29	3.22
17	3.17	3.19	3.21
18	3.44	3.29	3.31
Average	3.29	3.28	3.29

Number	New Method	Beimling
1	4.00	4.09
2	4.35	4.44
3	3.91	3.83
4	3.65	3.85
5	4.26	4.26
6	3.74	3.74
7	3.65	3.83
8	4.44	4.26
9	3.74	3.74
10	4.09	4.26
11	4.52	4.70
12	3.65	3.65
13	4.61	4.69
14	3.91	4.09
15	4.17	4.17
16	4.00	4.09
17	3.83	3.91
18	4.61	4.69
19	3.91	3.99
20	3.91	3.91
21	4.35	4.35
22	4.00	4.00
23	3.91	4.00
24	4.35	4.35
25	4.61	4.61
26	4.35	4.43
27	4.17	4.26

Number	New Method	Beimling
28	3.91	4.00
29	4.00	4.00
30	4.44	4.35
31	3.65	3.73
32	4.09	4.00
33	4.00	4.09
34	3.91	3.91
35	3.91	4.00
36	3.83	3.91
37	3.74	3.83
38	3.74	3.74
39	3.48	3.48
40	3.83	3.83
41	4.09	4.00
42	4.44	4.35
43	6.61	6.70
44	5.83	5.83
45	6.35	6.26
46	5.83	5.83
47	6.52	6.52
48	6.35	6.35
Average	4.92	4.35

The principal advantages of the new method over any other which we have used are:

1. A clear and sharply defined fat column which is easily read by either day or lamp light.

2. The accuracy of the results are not vitiated by the charring of the fat column.

3. The contents of the bottles never foam over.

4. It is the most rapid method we have found, six tests being made in duplicate in twenty-two minutes, and one test in duplicate in four minutes.

5. Cheapness, each test costing only about one-fifth of a cent.

Feeding for Milk and Butter.

E. R. LLOYD.

On January 18, 1892, thirty cows from the College herd were put into the Station barn for a continuation of the work of 1890 and 1891 in determining the relative values of different foods for the production of milk and butter. The herd was divided into six lots of five cows each, one cow from each lot being a grade Holstein and the remaining four grade Jerseys. The herd was so divided that, as nearly as possible, the cows in each lot should average the same time from calving. The test was continued five weeks, the first being considered preliminary, and the results for that week are not given. Each cow was given all the hay she would eat, and the average daily rations consumed were:

Lot 1—7.07 pounds Bermuda hay, 10 pounds ensilage, 7.8 pounds raw cotton seed.

Lot 2—4.9 pounds Timothy hay, 9.8 pounds ensilage, 8 pounds raw cotton seed.

Lot 3—7.5 pounds Bermuda hay, 9.9 pounds ensilage, 9.9 pounds steamed cotton seed.

Lot 4—6.5 pounds Timothy hay, 9.9 pounds ensilage, 9.9 pounds steamed cotton seed.

Lot 5—10.2 pounds Bermuda hay, 9.9 pounds ensilage, 8.8 pounds cotton seed meal.

Lot 6.—8.8 pounds Timothy Hay, 9.9 pounds ensilage, 8.8 pounds cotton seed meal.

The Bermuda hay was "choice" from J. C. Rand of Oktibbeha county, and the Timothy was also "choice" from Moon, Jones & Co., Memphis, Tenn. In estimating the cost of feeds, Bermuda hay is valued at $10,00 per ton, Timothy hay at $21,46, cotton seed at $6,00, cotton seed meal at $20,00, and ensilage at $2,00. The ensilage was given in equal quantities to all the lots and was added with the dry feeds to improve the appetite and to keep

the animals in better condition. The steamed seed was cooked with an "Allen Combined Feed Cooker," the increase in weight of the seed by steaming compensating for the extra labor.

In calculating the cost of milk and butter, no account is taken of the expense of milking, feeding, and attending to the cows, the experiment having been conducted to find the comparative values of the different foods, and as the cost of attention to the different lots would have been practically the same, the final results would not have been varied by adding this item.

The milk from each cow was weighed separately and the tests for butter fat were made daily, morning and evening, from the mixed milk from each lot. The testing was done by a new method devised by Mr. L. G. Patterson, one of the Station chemists, and which was tested thoroughly in comparison with the Gravimetric, Babcock, and Beimling methods and found to give equally good results before being adopted for the present work. A full description of the method will be found in part 2 of this bulletin.

The general results were as follows:

		Feed.	Cost of Feed	Morning Milk	Afternoon Milk	Average Test	Butter	Milk. Gallons	Milk. Cost per Gallon cts.	Butter. Pounds	Butter. Cost per pound cts.
Lot	1	Bermuda Hay, Ensilage, Raw Cotton Seed	9.65	728½	492½	5.35 6.55	38.899 34.217	152.6	6.3	73.116	13.2
Lot	2	Timothy Hay, Ensilage, Raw Cotton Seed	11.30	658½	432	5.21 6.25	34 269 27.029	136.3	8.3	61.298	18.4
Lot	3	Bermuda Hay, Ensilage, Steamed Cot. Seed	10.79	1025	723	5.21 6.48	53.446 46.899	218.5	4.9	100.345	10.9
Lot	4	Timothy Hay, Ensilage, Steamed Cot. Seed	15.32	856½	607½	5 19 6 56	44 532 39.840	183.0	8.4	84.372	18.1
Lot	5	Bermuda Hay, Ensilage, Cotton Seed Meal	20.88	1008½	690	5.16 6.33	51.445 43.825	212.3	9.8	95.270	22.0
Lot	6	Timothy Hay, Ensilage, Cotton Seed Meal	26.97	1016½	689½	5.15 6.26	52.902 43.087	213.2	12.6	95.989	28.1

The best results from the feeding were obtained from lot 3, fed on Bermuda hay, ensilage, and steamed cotton seed. This

lot gave the largest yield of milk and butter, producing milk at a cost of 4.9 cents per gallon, and butter at 10.9 cents per pound. The average content of butter fat for this lot was slightly lower than was that of lot 1, fed on Bermuda hay, ensilage, and raw cotton seed; and of lot 4, fed on Timothy hay, ensilage, and steamed cotton seed; but the larger quantity of milk produced more than compensated for the deficiency of one ninth of one per cent in butter fat. Lot 4, fed on Timothy hay, ensilage, and steamed cotton seed, (the same grain ration as lot 3) produced milk at a cost of 8.4 cents per gallon and butter at 18.1 cents per pound. In other words, the milk and butter from lot 4 cost about 65 per cent more than did that from lot 3.

The most expensive milk and butter were produced by lot 6, fed on Timothy hay, ensilage and cotton seed meal, the milk from this lot costing 12.6 cents per gallon and butter 28.1 cents per pound.

By comparing the averages of the three lots fed on Bermuda hay with the averages of the three lots fed on Timothy hay, (the grain rations being the same in both cases) it is seen that with Bermuda hay, milk was produced at a cost of 7.08 cents per gallon and butter at a cost of 15.5 cents per pound; while with Timothy hay milk cost 10.06 cents per gallon and butter 22.17 cents per pound.

If the Timothy hay could be purchased at the same price as was the Bermuda, these figures would be materially changed and the cost of the milk and butter would be practically the same, the exact figures being—

Bermuda. Cost of milk 7.08 cents per gallon; butter 15.49 cents per pound.

Timothy. Cost of milk, 7.04 cents per gallon; butter 15.51 cents per pound.

These figures indicate that, ton for ton, the two hays have practically the same milk and butter producing values, and that the one which can be purchased at the less cost per ton is the cheaper food. The results agree very closely with those obtained in 1890 and in 1891, and serve to confirm the conclusions published in Bulletin 15.

It should be observed that the figures given indicate only the relative cost of the milk and butter from each lot, though the real difference in values was much greater than is shown, the quality of the butter from the cows fed on steamed seed being much superior to that of either of the other lots, this being espe-

cially true of the two lots fed on raw and steamed seed. No difference could be observed in the quality of the butter made from the two kinds of hay.

The cows fed with Timothy hay made an aggregate gain of 250 pounds, against a gain of 148 pounds in those fed on Bermuda; and the cows fed with meal made a gain of 258 pounds against one of 124 pounds in those fed with steamed seed, and 16 pounds in those fed with raw seed.

By comparing the averages of the lots fed on steamed seed, raw seed, and on cotton seed meal, (the rations of hay being the same in each case) it is found that with steamed seed, milk was produced at a cost of 6.5 cents per gallon and butter at 14.3 cents per pound; with raw seed, milk was produced at 7.25 cents per gallon and butter at 15.58 cents per pound; and from cotton seed meal, milk was produced at a cost of 11.13 cents per gallon and butter at 25.02 cents per pound.

CONCLUSIONS.

From the work accomplished during the past three years it appears that:

1. Equal weights of Bermuda and of Timothy hays have practically the same values for the production of milk or butter.

2. At the prices at which they can be purchased in Mississippi, Bermuda hay will produce milk or butter at a much less cost than will Timothy hay.

3. The milk and butter from cows fed on steamed cotton seed costs less than that from cows fed on raw cotton seed, and but little more than one-half as much as that from cows fed on cotton seed meal.

4. The butter from steamed seed is superior in quality to that from either raw seed or from cotton seed meal.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 22.

GRAPES.

S. M. TRACY,
F. S. EARLE.

AGRICULTURAL COLLEGE, MISS.

SEPTEMBER, 1892.

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The bulletins of the Station are sent free of charge, to all farmers in this State who apply for them.

GRAPES.

The soil in which the station vineyard is planted is the yellow loam which is common in the northern half of the state. It contains but very little sand and is underlaid, at the depth of about a foot, with a very heavy red clay which contains a small amount of lime. The location is on the top of a ridge where the drainage is perfect, and the land had been in cultivation as a vegetable garden before the vineyard was planted. The holes in which the vines were planted were dug eighteen inches square, fifteen inches deep, and eight feet apart. Before planting, a large quantity of old bones was collected from the fields and slaughter houses, and from five to eight pounds were put in the bottom of each hole. This amount of bones was larger than was really necessary, or than would be economical if they had to be purchased at the ordinary rates, but as they were abundant and cost nothing but the hauling, we used them so liberally that the vines will need no further supply of such fertilizer for twenty years or more. The bones will decay very slowly and, being immediately under the vines, the roots can reach them easily and will absorb them as rapidly as their material is needed. The bones were covered with sufficient soil to prevent the roots of the vines from coming in direct contact with them at planting.

The first lot of vines was planted in March, 1888, and additions have been made to the vineyard annually since that time. We have planted vines one year old from cuttings, whenever it has been possible to obtain them, preferring them to older vines, and to those grown in the greenhouse from single eyes. At planting, the entire top of the vine is cut off, excepting the two buds immediately above the top of the original cutting, so that the new growth will start from very near the ground, and the greatest care is exercised to place the roots as nearly as possible in their natural position, and to fill around them closely with good soil which is fine and mellow. The future health and vigor of the vine depends largely upon the manner in which it is planted, and a little extra work at this time is amply repaid by increased growth and healthfulness. We use no tools except

ing bare hands for packing the earth about the roots, being careful to pulverize all lumps, and to have the soil packed firmly *below* each little rootlet. It is more important to have the soil well packed below the roots than above them, as in any case it will settle somewhat after the first heavy rain and, if not packed closely to the under side of the roots will settle away from them, while the soil above the roots, will settle so as to pack them closely on top. When the hole is filled the soil is well tramped, and a little loose soil scattered over the surface to prevent baking. No fertilizer, excepting the bones, is applied at planting.

It is a common practice to allow the vines to grow one year without any support, or at most, to tie them to a stake and to defer building a trellis until the next year; but in the long growing season of the Gulf States we have found it much better to build the permanent trellis at the time when the vines are planted. We have both vertical and horizontal trellises in use, and they are constructed as follows:

The vertical trellis is made by setting posts sixteen feet apart, the first one being four feet outside of the first vine, and the tops being five feet above the ground. The two posts nearest each end of the row are eight feet apart and are braced by nailing six-inch fence boards diagonally from the top of one to the bottom of the other. Three lines of No. 12 galvanized wire are stapled to the posts at 24, 40, and 58 inches from the ground, the wires being stretched as tightly as possible. The posts for these trellises cost us eight cents each, and the wire nine cents per one hundred feet, making the cost of material six dollars and thirty-two cents per one hundred vines.

The horizontal trellis has given us better satisfaction than has any other which we have ever seen, and is the one which we recommend for general use. In making it, the posts are set as for the vertical trellis, the tops are sawed off square at five feet from the ground, and a cross-piece of 2x4, two feet long is laid on the top of each, and nailed at right angles to the direction of the row. Three No. 12 wires are stapled to these cross-pieces, one directly over the post, and the others one inch from the ends of the cross-pieces. The cost of material is the same as for the vertical trellis, with the addition of the cross-pieces which cost

one cent each. Our reasons for preferring the horizontal trellis are, that it makes pruning much more simple and easy, that it keeps the lower part of the vine free from sprouts and branches which would interfere with cultivation, that it affords much greater protection to the growing and ripening fruit, that it holds the fruit where it can be easily reached in spraying, and that it gives partial immunity from the attacks of fungous diseases. It is a well known fact that very few fungi can germinate excepting in the presence of moisture. With the horizontal trellis, nearly all of the fruit is found hanging below the wires, where it is protected from rain and dew by the leaves, which are almost wholly above the wires, and so the spread of disease is, to a large extent, held in check. The overshadowing leaves also protect the fruit from sun-scald, from which many of the thin-skinned varieties suffer severely. Whatever style of trellis may be used, it should always run North and South, so that the fruit may be protected from the sun during the hottest hours of the day.

Our rules for pruning are very few and simple, and are based upon two facts, first; that the fruit is produced only on branches which grew during the previous year, and, second; that no vine should be allowed to intrude upon the space required by its next neighbor. With these two points in mind, pruning becomes a very simple matter. When the vines are trained on the vertical trellis we follow what is known as the "renewal system" by which we endeavor to remove all of the old wood and to cover the trellis with a new growth once in two years. The heaviest pruning is done during the winter, when we cut away all but the two or three youngest canes, preferring to leave only those which grew during the last season. If the vine has made three strong and vigorous branches from near the surface of the ground during the past season, we leave these only, and cut away all of the older wood. If, as is usually the case, the vine has made but one or two such branches, we leave the youngest of the older ones, cutting them off immediately above the first vigorous shoot, so that the largest possible proportion of the wood which is left on the vine shall be of the last season's growth. In this way a vine may be renewed every year, or it may take two or more years to complete the renewal. The branches which are left are cut off

at or below the top wire and from three to six side branches, shortened to from three to six joints in length, are left on each. The stronger the growth of the vine, the more wood we leave when pruning, and as soon as the pruning is completed the vines are tied to the wires, one being fastened vertically and the others diagonally, so as to give each branch as much room as possible. In the early summer, after the fruit is set, we prune again, this time almost wholly with the thumb and finger, breaking off the ends of the bearing shoots two or three leaves beyond the last bunch of fruit, and removing all barren shoots excepting the two or three nearest the ground. When we can find vigorous shoots coming from near the ground we tie them to the trellis, but it is often the case that we have no new shoots excepting those which come from the old canes at some distance from the roots, and then the lowest strong shoot on each branch is left and tied to the trellis.

With the horizontal trellis we follow an entirely different and a much more simple method. When the vines are planted a stake five feet long is set by each one. When the vine begins to grow it will usually send out two or three shoots, and as soon as these are an inch or two long, all except the strongest one are broken off, the remaining one being tied to the stake. Other shoots will probably start from near the root later, but they should be broken off as soon as they appear, so as to throw the entire strength of the plant into the one cane which is to form the future vine. This is tied to the stake as frequently as is necessary until it reaches the middle wire on the top of the trellis, when the end is broken off. The two buds nearest the broken end will send out shoots or arms which will fasten themselves to the wire by means of their tendrils. A very little care will keep them on the middle wire, and when the ends of the arms have reached half way to the next vine, their ends should be broken off so that the remainder of the growth for the season may be used in the development of side shoots which will be supported by the side wires of the trellis. When properly planted and cared for, the vines will grow so as to fully cover the trellis the first season, and the stakes to which they were tied may then be removed.

The pruning may be done at any time after the leaves drop,

and in this latitude should be done before the first of February as, if the pruning is deferred beyond that time, the vines will bleed severely. In pruning the vines on the horizontal trellis, we leave from three to six of the side branches on each half of the vine, cutting them back to three or four joints each. All other side branches are cut off close to the arm. During the summer we do but little pruning with the knife, but prune frequently with the thumb and finger. The ends of the bearing shoots are pinched off two or three leaves beyond the last cluster of fruit, and most of the barren shoots are removed. Remembering that the fruit of next year will be produced on the new wood of this year, we do not break off all the barren shoots, but leave from four to six of the strongest and best on each of the two arms, especially those which grow from the joints where the side shoots were cut close the previous season. The pruning done during the second and succeeding winters is on the same plan as that of the first winter. The side shoots which have borne fruit during the season are cut off close to the arm, and from four to six of those which have grown during the present season are left on each arm to produce fruit the next year.

The important point to be remembered in pruning is, that all the fruit is made on wood which grew during the previous season. The natural tendency of the vine is to make its new growth and to bear its fruit at the greatest possible distance from the root. As we do not wish to provide either trellis or land for each vine to grow to an indefinite length, we prune so as to induce as much growth as we can as near the roots and in as small a space as is possible. Such pruning as we practice looks severe, for we usually cut away fully three-fourths of the vine each year, but such pruning will make a greater yield of fruit per acre, if not per vine, than can be secured by allowing the trellis to become covered with a tangled mass of old and barren vines. Grapevines need more pruning than do other plants, as the cutting away of the old wood induces a stronger growth of new shoots, and it is upon these new shoots only that fruit is produced the following season. It is impossible to give explicit directions for pruning which can be followed in all cases, as we never find two vines exactly alike, and the pruning must be as various

as is the growth of the vines. Strong growing and vigorous varieties like the Niagara and the Herbemont should not be pruned as closely as the weaker growing sorts like the Delaware and the Ulster, but in general cultivation, especially on a small scale, a thousand vines are pruned too little for every one that is pruned too much.

We have never given our grapevines any special cultivation beyond what has been necessary to keep the ground mellow and free from weeds. As soon as we finish pruning we rake up all the branches which have been cut off, the dead leaves and other trash, and burn them. When the buds begin to swell we plow with a one-horse turning plow, throwing the furrow away from the vines, and then hoe the narrow strip which the plow cannot reach. About a month later we plow again, throwing the furrow towards the vines, and all subsequent cultivation is done with a five-toothed cultivator. Before the first plowing a shovelful of wood ashes is thrown at the roots of each vine, and cow peas are sown broadcast after the crop is gathered. No other fertilizers are used.

The diseases which affect the grapes on the Station grounds are practically the same as those which are mentioned by Mr. Earle on a following page, with the exceptions of the powdery and the downy mildews which are almost unknown, the former having been observed in September of this year for the first time, and the latter never having been seen here. The "black rot" is seen occasionally, but does very little harm in comparison with that done by the "ripe grape rot" which almost wholly destroys some varieties, especially the late white varieties like Duchess. Our experience with these diseases has been so similar to that of Mr. Earle that it need not be detailed here. Bordeaux mixture and Eau Celeste have been used promptly and thoroughly for four years, and have afforded no protection from either anthracnose or the "ripe grape rot." Sacking has proved an almost certain method for preserving the fruit from all fungous attacks, and has become our main reliance for securing perfect clusters of all choice varieties. For this work we use the ordinary one-pound paper sacks from the grocery store, slipping them over the clusters as soon as the fruit is as large as small shot, and fastening

the mouth of the sack around the stem by means of a pin. The work can be done very rapidly, and the cost for sacks and labor does not exceed half a cent per pound for the fruit.

The following are among the varieties which we have grown here:

AGAWAM: One of Roger's hybrids; a good grower and very productive, but the clusters are usually ragged and uneven; fruit large, purplish, ripe about Aug. 1, and of the best quality.

BERCKMANS: Much like Delaware, but the vine a stronger grower and the fruit with a more sprightly flavor. Two years ago we regarded this as our best red variety, but the last two crops have suffered severely from rot.

BLACK JULY: Similar to the well-known "Norton" but not so prolific though better in quality. An excellent variety for wine, but too acid for the table.

BRIGHTON: This has often been called "The best red grape in America." The vine is fairly vigorous and quite productive; fruit red, large, and of the best quality, ripening about the middle of July. Our experience, both here and elsewhere, has been that the vines will bear only one or two good crops, and that as they grow older they become more and more subject to disease, and not worth keeping.

BRILLIANT: We regard this as the best red grape we have ever grown. The vine is a good grower, perfectly healthy, and bears well. The bunches are of good size, fruit red, nearly as large as Concord, and of the very best quality, ripening July 20, with very little rot.

CARMAN: This is a new variety which, we understand, will not be offered for sale until next year. The vine is a very strong grower, bunches large and compact, fruit medium sized, nearly black, skin thin, pulp tender and highly flavored. Ripens Aug. 1, and, so far, has been free from rot.

CHAMPION: The earliest ripening sort we have grown, maturing well by July 10. The vine is vigorous and very prolific, bunches and berries medium in size, black, and free from rot. Fruit very poor in quality, but it ripens so early that it is valuable for market.

DELAWARE: Bears more freely here than at the north, and is almost wholly free from disease. Here it matures about July 15, and is one of our best varieties for either table or market.

DIAMOND: Vine vigorous and prolific, fruit large, greenish white, juicy and tender; ripens July 20, and is of excellent quality, but subject to rot.

DUCHESS: A moderate grower and a prolific bearer, ripening about the middle of July. The fruit is white, small, and of the very best quality, but suffers severely from rot. Mr. J. W. Treen, of Poplarville, Miss., has grown this variety for some years, and regards it as being one of his best, but on the very different soil at the Station it is almost worthless.

EATON: One of the strongest growing vines, and an abundant bearer. The berries are very large, nearly black, and of excellent quality. It suffers but little from rot, and begins to ripen about July 20, but ripens unevenly, so that green and ripe berries are usually found on the same bunch.

GREEN MOUNTAIN: A medium grower, and very prolific. Fruit white, tender, juicy, and of excellent quality, ripening earlier than does any other white variety. The fruit is too tender to bear shipping well, but it is one of the best varieties we have tested for home use.

HERBEMONT: A well-known variety which grows and bears well in the central and southern part of the state, but does not succeed as well in the north. The fruit does not ripen until the middle or latter part of August, and is of the very best quality. One of the best late ripening varieties.

HERMAN JAEGER: This is one of the new varieties which has been very highly recommended, but which has not succeeded here as well as we had hoped. We fruited it this season for the first time and found the vine very vigorous, the bunches unusually large, the berries medium in size, dark purple and only fair in quality. It ripened July 25, and suffered severely from rot.

IVES: A strong grower, and very prolific, ripening about July 15. Its quality is poor, but it bears so freely and ripens so early that it is one of our best black varieties for market.

JEFFERSON: Vine a moderate grower, bunch and berries large, fruit red, sweet, and well flavored. Ripens Aug. 1 and is an excellent variety for either table or market.

LADY WASHINGTON: A variety which originated some years ago in New York, where it has done well, but it has not been satisfactory here. The vine is vigorous and prolific, the bunches are very large, the fruit large, pale red and of fine flavor, but so subject to disease as to make it undesirable.

MISSOURI REISSLING: Not a strong growing vine; fruit small, reddish green, very tender, juicy, and sweet; ripening July 25. Not so good here as when grown further north.

MOORE'S EARLY: Vine very vigorous, bunches small and loose, berries very large, black, sweet and good. Much like Concord, but ripens some days earlier and has been less affected with rot.

MOYER: One of the best early ripening sorts. Vine and fruit much like those of Delaware, and equally free from disease. Excellent for both table and market.

NIAGARA: A large, white variety which bears well and is almost wholly free from disease. The clusters and fruit are about the size of Concords, the berries white and of very good quality. We think this one of the best varieties for general cultivation for either table or market.

PERKINS: An excellent early market variety which is wholly free from disease. Vines vigorous and productive, berries large, red, and with a peculiar "foxy" flavor which is relished by some, though distasteful to others. One of the best sorts for market.

PETER WYLIE: A strong growing variety, ripening about the middle of July; fruit medium in size, light yellow, and of the best quality, but liable to disease.

POUGHKEEPSIE: Very similar to Berckmans, but is more affected by rot. The fruit ripens July 15, and is of excellent quality, but it is so difficult to secure perfect bunches that it cannot be recommended for market.

ROMMEL: A cross of Triumph and Elvira, from T. V. Mun-

son. Vine a good grower, bunch and berry above medium in size, fruit white and of the best quality. One of the most promising of the recent introductions.

TRIUMPH: A very showy and productive variety. Vine vigorous and healthy, bunches very large, berries medium in size, white, excellent in quality. Ripens about the middle of August, and is one of the best of the late varieties.

WORDEN: Similar to Concord, but larger and better in quality. The bunches ripen very unevenly, both here and at the Ocean Springs Station, so we cannot recommend it for market, though it is excellent for home use.

FOREIGN VARIETIES: We have made repeated plantings of a large number of varieties of European and Californian origin, but all have been failures. In many cases the vines have made a fair growth for a year or two, but they soon succumb to the attacks of the phylloxera, and the little fruit which has set has been destroyed by anthracnose.

[NOTE.—The Ocean Springs Station is in charge of F. S. Earle, who makes the following report:

The Season's experience confirms the opinion that grapes, as a market crop, can be successfully cultivated here. The vines grow freely, are comparatively healthy, and thrive on land that would be decidedly too wet for peach trees.

VARIETIES:

Of several varieties that have been under observation, the following seem best suited for general cultivation: Ives, Champion, Delaware, Niagara, and Concord. The last has the serious fault, in some seasons, of ripening unevenly on the bunches, some berries remaining green and hard after the greater part of the bunch is fully ripe, making necessary a tedious amount of trimming, when packing for market. This season the bunches have ripened more evenly and there has been little of this trouble. Ives and Champion, while poorer in quality than Concord, ripen decidedly earlier and more evenly and stand shipment better. In the writer's opinion, they will prove more profitable for distant

markets. Delaware does quite well but requires close pruning and good treatment in order to ripen satisfactorily. In moderate quantity, it always commands high prices, but markets are eas ily over-stocked with it. Niagara has, on the whole, been more satisfactory than any other variety observed. It bears abundantly, ripens a week earlier than does the Concord, and ships fairly well. So far it has brought fair prices, but, if offered in as large quantity as the black grapes, it is doubtful if it would bring any more money.

Moore's Early, Early Victor, and Worden have all proved unsatisfactory; the Worden has the uneven ripening fault of the Concord greatly intensified, half the berries in a bunch remaining perfectly green after the rest are so ripe as to split open and sour if it rains.

Of varieties that have, so far, been grown only in an experimental way, Brighton, Wilder, and Black Eagle are very promising. Their future behavior will be watched with much interest.

It was hoped that among the many varieties originated by Mr. T. V. Munson of Texas, some might be found specially adapted to this climate. Of those under observation, none equaled the well known kinds mentioned above, though both Red Eagle and Grayson have considerable merit.

Several varieties of European grapes, including Black Hamburg, White Muscat, and Flame Tonkay, have been tested here, but with little promise of success. They incline to start too early in the spring, and are often damaged by frost. The powdery mildew (Uncinula) also injures them severely and there is a general lack of vigor in the vines.

DISEASES.

The ordinary black rot of the North is almost or quite unknown here. With this exception, the common grape diseases such as Anthracnose (Sphaceloma), downy mildew (Peronospora), powdery mildew (Uncinula), leaf blight (Cladosporium), etc., have all been observed but so far have done very little damage. The Peronospora has been observed only on Delaware and Triumph late in the season; and the Uncinula is injurious only on European varieties.

In the so-called "bitter rot" (Melanconium fuliginium) however, we have a serious enemy and one that does not yield readily to any of the remedies recommended for the other diseases. This disease, although observed in a number of localities, seems to have attracted little attention either from horticulturists or from mycologists. It might with propriety be called the "ripe rot" of the grape, as it does not appear until the fruit begins to ripen. Then, scattered berries are seen that look as if scalded or sunburned on one side. The diseased condition spreads rapidly under favorable conditions of heat and moisture and soon reaches the stem where the principal mischief is done. If the bunch is almost ripe when attacked, only a few of the berries may be injured, but the cluster is ruined for shipping; for the stem, instead of becoming limp and yielding after picking, as in a properly cured healthy cluster, is dry and brittle and the berries drop off at a touch. Even if the bunch holds together to go into the basket, the motion of the cars loosens the berries from the brittle stems and it reaches market shattered and unsightly though the fallen berries may be uninjured and perfectly good to eat. The disease seems usually to travel from the berry to the stem but it is not necessarily communicated from the stem to other berries. If the cluster is attacked just as it begins to ripen the result is even worse, for the diseased stems fail to nourish the berries which shrivel slightly and do not ripen but fall to the ground when the vine is stirred. The diseased berries are at first rather inconspicuous and, on the light colored varieties, might easily be overlooked by the casual observer. There is no shrunken spot as in the black rot, since the disease does not appear until the berries are full grown; on the contrary, the affected berries are rather full and turgid with a slightly discolored watery look on the diseased side; they appear at first as if scalded by the sun. Later on, the fruit pustules of the rot are visible. To the naked eye, these seem much as in black rot but they are perhaps rather more prominent and are scattered somewhat evenly over the surface of the berry instead of being confined to definite diseased areas, as in the black rot.

Not content with injuring the fruit and stems while still on the vines, this rapidly developing disease follows up its work af-

ter the grapes are picked if they are stored in a close place, or while on the way to market. My attention was first called to the difference between this and the black rot some two years ago by observing that comparatively sound bunches, left in a fruit dish on the side-board in two or three days became rotten and worthless, the disease spreading almost as fast as rot in peaches would have spread under similar conditions. One Monday morning this summer, a New Orleans commission merchant showed me a lot of Delawares which had arrived in good order on Saturday but had been held over hoping for a better market. The weather was warm and damp and, on opening the baskets Monday morning, they were found to be so badly rotted that they were finally closed out to a peddler for less than one third of the price of good stock. Many of the baskets were absolutely worthless.

Last year the thirty acre vineyard of the Winter Park Co. was all thoroughly sprayed six or seven times with Bordeaux mixture and Eau Celeste, as recommended by the U. S. Dep't of Agriculture for the black rot and downy mildew, but the spraying did not prevent a considerable loss from this bitter rot. This year the vineyard was not sprayed at all, and the percentage of loss was little if any greater than before, though the season was equally favorable for the development of the rot. After three years experience, I cannot see that treatment with the copper compounds has any appreciable effect in preventing this disease, and all varieties seem liable to attack, though the thin skinned white varieties are probably most susceptible. As the disease does not appear until late in the season, the earliest ripening kinds escape with the least damage. It is also a noticeable fact that, on vigorous vines, the bunches that hang so as to be well protected by the foliage are almost uniformly exempt. It is the bunches on feeble vines and especially those that are fully exposed to the sun and dew that are usually attacked; in fact, very few bunches that hang fully exposed to the weather ripen perfectly. In this connection it may be noted that the horizontal trellis, where the vines are trained on three or more wires stretched side by side, gives much better protection to the bunches, which thus hang below the foliage. Much better results are secured than from a vertical trellis or from training the vines to a single wire or tying them to a stake.

It seems therefore that by selecting strong growing kinds, pruning and cultivating to secure a vigorous growth, and training so as to give the greatest possible protection to the fruit, we may escape serious damage from this disease except in unusually wet seasons. For the past two years, shipments of Ives have begun from this place on July 4, and the last Concords have been marketed by July 25. Unfortunately, July is usually one of our wet months, showers often being of daily occurrence. But for this fact, it is not likely that the bitter rot, or, as I prefer to call it, the "ripe grape rot," would ever prove seriously injurious.

SUMMARY.

1. Grapes seem perfectly at home here. They grow and bear well even on rather wet low ground.

2. Common vine diseases occur but are not specially destructive.

3. Varieties well adapted for general cultivation in the Coast region are; Ives, Champion, Delaware, Niagara, and Concord; for cultivation further north we recommend Moore's Early, Delaware, Brilliant, Niagara, Eaton, Triumph, Rommel, and Herbemont.

4. The European varieties do not give much promise of success. They start too early and are subject to mildew.

5. The much dreaded black rot is not known or at least is not so common as to be troublesome.

6. In the bitter rot, or ripe rot, we have a serious enemy. It does not yield to treatment with fungicides, but may be partially controlled by methods of training and culture. It continues to develop on the fruit after it is picked. It is aggravated by the wet weather which occurs in July, when the grapes are picked.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 23.

VARIETIES OF COTTON.

E. R. LLOYD.

AGRICULTURAL COLLEGE, MISS.

FEBRUARY, 1893.

VARIETIES O

The following table gives the yield, quality, and total values per acre Station in 1892. All were grown on low land which was very even in qua received an application of "Furman's Formula," put in the drills before lint from the different varieties, the "Class" and "Remarks" were made on February 2d, when "middling" cotton was worth 9 3-16 cents per pound i

NAME.	Addresses of Parties from Whom Seed was Received.	Date of Heaviest Picking.	Weight of Seed Cotton per Acre. Pounds.	Per Cent. of Lint to Seed Cotton
Allen	J. B. Allen, Port Gibson, Miss	Sept. 27	587	26.06
Bragg's Long Staple	T. J. King, Louisburg, N C	Sept. 10	437	29.98
Cherry Long Staple	J. G Lee, Calhoun, La	Sept. 27	417	30.03
Cochran's Extra Prolific	M. W. Johnson Seed Co., Atlanta, Ga	Sept. 10	561	30 72
Coltharp's Pride	A. S. Coltharp, Milliken Bend, La	Sept 27	458	30.77
Cook	W. A Cook, Newman, Miss.	Sept. 27	617	26 88
Dickson's Improved	C. Dickson, Oxford, Ga	Sept. 27	719	30.84
Drake's Cluster	R. W Drake, Laneville, Ala	Sept. 27	989	30.56
Eureka, Coltharp	A. S. Coltharp, Milliken Bend, La	Sept. 27	557	28.05
Eureka, Humphrey	D. G. Humphrey, Dalkeith, La.	Sept. 27	661	27.71
Herlong	Alexander Drug & Seed Co, Augusta, Ga	Sept. 10	519	28.77
J. B. Warren	J. B Warren, Ennis, Miss	Sept. 27	991	33.28
Jones' Long Staple Prolific	J H Jones, Herndon, Ga.	Nov. 8	894	30.32
King	T J. King, Louisburg, N. C	Sept. 10	849	33.79
Marston Prolific	H. C. Prevost, New Orleans, La	Sept. 27	495	31.76
Matthew's Extra Long Staple	J. A. Matthews, Holly Springs Miss.	Sept. 27	635	30.65
Okra Leaf	Alexander Drug & Seed Co, Augusta, Ga	Sept. 10	675	31.03
Peterkin Improved	" " " "	Sept. 27	486	33.33
Peterkin New Cluster	" " " "	Sept. 27	481	33.26
Petit Gulf	H. C Prevost, New Orleans La	Sept. 27	424	30.42
Smith's Standard Improved	M. W. Johnson Seed Co , Atlanta, Ga	Sept. 27	810	34.15
Southern Hope	E. J. McGehee, Pinckneyville, Miss.	Sept. 27	765	28 22
Tennessee Gold Dust	Jenkins & Trobaugh, Brunswick, Tenn	Sept. 10	670	31.72
Texas Storm Proof	W. J Smilie, Baileyville, Texas	Sept. 27	561	34.26
Truitt's Premium	G. W. Truitt, La Grange Ga	Sept. 27	914	29.58
Willis	J. B. Allen, Port Gibson, Miss	Nov. 8	789	28.43
Averages			**652**	

TON, 1892.

venty-six varieties of cotton which were grown by the Experiment ell drained, and which had been cultivated in corn in 1891. The field g the cotton, at the rate of 1000 pounds per acre. The values of the e Committee on Classification of the New Orleans Cotton Exchange, market. The seed is valued at twenty cents per bushel.

Weight of Lint. Pounds.	Price per Pound of Lint. Cents.	Value of Lint.	Value of Seed.	Total Value of Crop per Acre.	CLASS.	REMARKS.
153	12	$18.36	$2 60	$20.96	Strict Middling.....	1⅛ Staple.
131	9¾	12 77	1.84	14.61	Good Middling	1⅛ Staple.
125	9⅜	11 72	1 75	13.47	Strict Middling	Fair ⅞ Staple.
172	9⅜	16.12	2.33	18 45	Strict Middling . . .	⅞ Staple.
141	10	14.10	1 84	15 94	Good Middling	1 3-16 Staple.
166	13	21.58	2 71	24 29	Strict Middling.....	1 9-16 Staple, Ex Char't'r
222	9½	21 09	2.98	24.07	Strict to Good Middling..	⅞ Staple—Strong.
302	9⅜	28.31	4.12	32 43	Strict Middling	Fair ⅞ Staple.
156	10½	16 38	2 41	18.79	Strict to Good Middling	1 5-16 Staple.
183	10½	19 21	2.87	22.08	Strict Good Middling ...	1¼ Staple.
149	9½	14.15	2 22	16 37	Strict to Good Middling	Very Short Staple.
330	9⅝	31.76	3 97	35.72	Good Middling	⅞ Very Strong Staple.
271	10⅝	28.79	3 74	32.53	Good Middling.....	1 5-16 Staple.
287	9½	27.26	3 37	30.63	Strict to Good Middling	Very Short Staple.
157	9⅝	15.11	2 03	17.14	Strict to Good Middling	1⅛ Staple.
195	11	21 45	2.64	24 09	Strict Middling	1⅛ Staple.
209	9⅞	20.64	2.80	23.44	Strict to Good Middling	1 3-16 Staple.
162	9½	15 39	1 94	17.33	Strict to Good Middling	Very Short Staple.
160	9⅝	15.40	1 93	17 33	Good to St Good Midd'g	Very Short Staple.
129	9⅝	12.42	1 77	14.19	Strict Middling	1⅛ Staple.
277	9½	26 31	3 20	29.51	Strict to Good Middling	⅞ Staple.
216	10	21.60	3.29	24 89	Middling	1 5-16 Staple.
213	9⅝	20.50	2.74	23.24	Strict to Good Middling	1 1 16 Staple.
192	9½	18.24	2 21	20.45	Strict Middling	1 inch Staple.
270	9⅝	25.30	3 86	29.16	Strict Middling	Fair ⅞ Staple.
[illegible]	11	24.64	3 39	28.03	Good Middling	1⅛ Scant Staple.
[illegible]		**19.95**	**2.71**	**22.66**		

It will be seen from the table that the five varieties giving the highest values per acre were "Warren" $35.72, "Jones' Long Staple Prolific" $32.53, "Drake's Cluster" $32.43, "King" $30.63, "Smith's Standard" $29.51. Of these, only one ("Drake's Cluster") ranked among the first five in 1891, and "King" is the only one which was among the best in 1890. "Warren" was planted this season for the first time.

When the crop of 1891 was valued, "middling" cotton was worth seven cents, and long staples from eleven to fifteen cents. This year the price of the short staple has advanced fully forty per cent., while that of the long staple has increased in price only about ten per cent. This gives the short staple sorts a much better showing than they made either one or two years ago, and so would make any comparison of values quite misleading. The five varieties giving the heaviest yields per acre were: "Warren" 330 pounds, "Drake's Cluster" 302 pounds, "King" 287 pounds, "Smith's Standard" 277 pounds, "Jones' Long Staple Prolific" 271 pounds. A reference to the table will show that of these, all except the "Jones" are very short, and even that is given as 1 5-16 inches. During the last five years the Station has tested sixty-eight varieties, and the results show that any variety will vary greatly in different seasons and when planted in different localities; and that it is seldom that any long staple sort is as profitable in the hill regions of the State as are some of the short staple sorts, while in the swamp regions the reverse is usually true. This matter was treated quite fully in the Station Report for 1891, of which we still have a number of copies which will be sent to those desiring them.

The Station has no seed of any of the varieties for sale or for distribution, but the addresses of the parties from whom our supply was received is given in the second column of the table.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 24.

FERTILIZERS FOR COTTON.

W. L. HUTCHINSON.
L. G. PATTERSON.

AGRICULTURAL COLLEGE, MISS.

FEBRUARY, 1893.

FERTILIZERS FOR COTTON.

On account of the great importance of cotton to the South, and because of the early exhaustion of the soils on which it was grown, the manurial requirements of cotton on various soils have been carefully studied at a number of Experiment Stations and Colleges, and also by successful farmers and planters. The scope of these field tests embraced trials with all the fertilizing materials on the market. The various forms of Nitrogen, whether of mineral, vegetable or animal origin—as nitrate of soda, sulphate of ammonia, cotton seed meal, castor pomace, fish scrap, dried blood, tankage, Peruvian and bat guano—have been tried; Phosphoric Acid in its various forms of water-soluble, citrate-soluble and insoluble as found in acid phosphate, dissolved bones, ground bones, floats, and other phosphatic materials; Potash, as muriate, sulphate and carbonate, have all been tried alone and in combination with each other; in large quantities and in small quantities. These experiments have been repeated for a number of years. They have been tried on different classes of soils, so that we have a great deal of positive information regarding the fertilizer requirements of cotton.

The different forms of Nitrogen seem to be equally valuable for cotton. The same is true of the different forms of Potash. Of the different forms of Phosphoric Acid, the water-soluble is decidedly the most valuable.

The best results are obtained by different proportions of Nitrogen, Phosphoric Acid and Potash on different classes of soils. Some soils do not respond to commercial fertilizers at all.

SANDY LANDS.

Sandy and sandy-loam soils respond well to applications of fertilizers of all kinds. When properly managed, fertilizers pay on these soils. It is principally on this class of lands that the hundreds of thousands of tons of commercial fertilizers, sold annually for cotton, are used.

A fertilizer which contains two and a half per cent of Nitro-

gen, eight per cent. of water-soluble Phosphoric Acid, and two per cent. of Potash, is well adapted to cotton on this class of lands. Two hundred to six hundred pounds should be used per acre, though larger amounts may be used with profit.

RED LANDS.

Red sandy lands with clay subsoil do not need Potash yet. Hence it is a waste of money to buy Potash for these soils. Fertilizers for cotton on these soils should contain three per cent. of Nitrogen and eight to ten per cent. of water-soluble Phosphoric Acid. The same quantities should be used per acre as on sandy soils.

PRAIRIE LANDS.

Black and gray prairie soils, such as constitute the "Black Belt" of Alabama and the Northeast and Central Prairie Regions of this State, do not respond to fertilizers. Fertilizers in large quantities frequently fail to increase the yield of cotton a particle.

These lands are still very rich in plant food, and their "exhaustion," or failure to produce cotton as they formerly did, is due to their wretched mechanical condition. By tile drainage, the growth of tap-rooted plants—such as Melilotus, Red Clover and Cow Peas—and deep plowing, the mechanical condition of these soils can be readily improved, so that large crops of cotton may be grown, as in former years when their yield was from one to two bales per acre. If these lands were managed properly they could be made to yield cotton as bountifully as the rich Delta region of this State.

YELLOW LOAM LANDS.

The results obtained from the experiments which have been made indicate that Potash is more needed for cotton than any other one ingredient, though a fertilizer which contains a small amount of Nitrogen and water-soluble Phosphoric Acid and a high percentage of Potash seems to more adequately meet the demands of these lands.

BLUFF FORMATION.

The brown loam soils of the Bluff Formation respond well to fertilizers. According to experiments made for three or four years on this class of soils at Baton Rouge, La., the requirements for cotton on these soils are similar to those on sandy-loam soils. They respond well to a fertilizer which contains three per cent. of Nitrogen, eight per cent. of water-soluble Phosphoric Acid, and two per cent. of Potash, when applied at the rate of two to four hundred pounds per acre.

STABLE MANURE.

The value of stable manure varies from about $2 to $13 per ton. The difference in value is principally due to the kind of animals from which it is obtained, the food of the animals and the manner of collecting and keeping the manure. One of the best methods of keeping manure is to allow it to accumulate in the stalls where the animals are kept, enough litter being placed in the stalls to keep them dry. The manure obtained by feeding the proper proportion of good hay with cotton seed or cotton seed meal or corn is of the most valuable kind. To allow stable manure to heat, or to be leached by rains, is very injurious and may render it practically worthless. Stable manure readily undergoes chemical changes, in most of which there is loss of fertilizing ingredients, hence the greatest good is obtained when it is scattered on the land while fresh and plowed under.

COMPOST.

A compost made of a hundred bushels of stable manure, a hundred bushels of cotton seed and a ton of Acid Phosphate, when mixed thoroughly to obtain uniform composition, makes a good fertilizer for cotton. Four hundred to six hundred pounds should be applied to the acre.

HOW FERTILIZERS SHOULD BE APPLIED.

All commercial fertilizers, as well as the above compost, when applied in quantities less than a thousand pounds per acre, should be applied in the drill. The best results are obtained when the fertilizer is mixed with the first three inches of the soil. Stable manure should be scattered broadcast on the land as it is hauled to the field.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 25.

Colic in Horses and Mules.

TAIT BUTLER.

AGRICULTURAL COLLEGE, MISS.

JUNE, 1893.

The bulletins of the Station are sent free of charge to all farmers in this State who apply for them.

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COLIC IN HORSES AND MULES.

Many diseases of the digestive system, varying widely in nature and causation, are generally included under the above name. Veterinarians however, usually recognize but two forms, viz: spasmodic (cramp), and flatulent (wind) colic. Enteritis, or inflammation of the bowels, is closely allied to spasmodic colic in the matter of symptoms as generally observed by stock-growers, and the same relationship exists between flatulent colic and acute indigestion, or impaction and fermentation of the food in the stomach. These four diseases, flatulent colic, acute indigestion, spasmodic colic, and enteritis are the most common of those diseases affecting the digestive system of mules and horses in Mississippi, and in this bulletin they will be considered with a view to assisting the farmer in their prevention and treatment.

For the prevention of any disease an intimate knowledge of its causes is essential, therefore we will first consider

THE CAUSES OF COLIC.

Nineteen out of every twenty cases may properly be charged to some irregularity in food or water.

WATER.—The water supply for working stock is an especially important matter, but one which receives little attention from Mississippi stock-owners. So long as an animal will drink it, no water is considered too foul for either horses or mules. Not only is this neglect on the part of stock-owners responsible for many cases of colic, but many other diseases also are directly traceable to impure water. An unlimited supply of good pure water is essential to the health of all animals used for farm work. Pools formed from surface drainage where large quantities of organic matter are carried into them, and wells or pools contiguous to barnyards or manure heaps, are especially to be avoided. Water from good cisterns or wells, running streams, and pools properly constructed, is usually good, but too much care cannot be taken in reference to this matter. The quantity of water is also of importance. No animal will drink too much if watered sufficiently often, hence there is no necessity for limiting the supply except when the animal has been deprived of water for too long a time. Animals at rest should be given water at least three times a day in summer, and twice a day in winter, if they cannot have free access to it at all times. Working animals should be watered more frequently, and in warm weather should

be watered five times daily. There is a common error that horses should not be watered when warm. *An animal is never too warm to be watered* if not more than two gallons be given. A large quantity of water will injure an animal at any time, but especially is this so when he is very warm or much fatigued. The watering of animals immediately after feeding, as frequently practiced, is not in harmony with the physiology of digestion. The stomach of a horse is very small in proportion to his size and the quantity of food he consumes, hence only a small amount of water can remain in the stomach, and if given immediately after feeding, undigested food must of necessity be carried with it in its passage through the stomach into the intestines. Another reason why animals should not be watered immediately after feeding is that digestion begins only when the food has been warmed to a temperature of about 99°F, therefore if a large quantity of cold water be mixed with the food the temperature of the contents of the stomach must be lowered, and consequently digestion much retarded. The rules for watering, briefly stated, are as follows:

1. Use only pure water.
2. Water before feeding.
3. Water frequently (from three to five times daily).
4. Never give a large quantity at one time, especially if the animal is very warm, or about to undergo severe exertion.

Food.—The quality and quantity of food, and the regularity with which it is given, are of the greatest importance. Oats is the best grain for horses or mules, though corn is more commonly used in this State, and is a good food if used with discretion. Oats are better because they are more easily digested, and possess the essential constituents of a good food in better proportions, and therefore, by throwing less work on the digestive organs, are less liable to cause indigestion and colic. They should be dry, clean, and free from must. If cut before they are too ripe their value is greatly enhanced. While corn is a fruitful cause of colic, yet it is a good food for working stock, but should be fed with caution. Oats and corn may be fed whole to a grown horse while his teeth remain good, but for colts and old horses they are better if ground. Bran, linseed meal, etc., if fed in small quantities and with other foods, are beneficial in keeping the bowels loose and in good condition. Almost any of the varieties of hay in common use may be fed with safety if they are cut before becoming too ripe, are well cured and free from mould. New hay should never be fed to working stock, as it is very apt to cause derangement of digestion, and so cause colic. The

quantity of food to be given must depend largely upon the amount of work required from the animal, and his individual peculiarities. From four to eight quarts of oats, or from eight to fifteen ears of corn, two or three times daily, are about the proper limits. The quantity of hay required is usually from ten to twenty pounds daily.

The manner of feeding is a very important consideration. If a horse is required to do more work than usual on a given day it is a common custom to give him more food. This is a great mistake. Owing to the fatigue consequent to the increased exertion the animal is less able to digest a large feed, and therefore should be fed less, instead of more. Again, it is decidedly improper to give a horse a large feed, especially of corn, immediately after undergoing severe exercise. If a large feed be given immediately before active exercise the blood which is required by the digestive organs in order to carry on their proper functions goes to the muscular system, digestion is impaired, and colic is a possible result. If a large feed be given immediately after active or prolonged exercise the animal is weak, and the blood is drawn upon largely for the rebuilding of the muscular waste, and the digestive organs suffer accordingly.

A change of food should be made with caution. If a change must be made, a smaller quantity of the new food should be given for several days, and the amount increased gradually. In no case should a change of food and work be made at the same time. A good rule is, *never give a horse a full feed on a change of work, nor full work on a change of feed.*

Instead of feeding a large number of mules together, giving the grain in large quantities and using foul water and that only when convenient, as is now the common practice, if the following method be pursued the great loss of mules by colic now experienced by Mississippi planters would be reduced at least three fourths. The mule should be watered and then fed at least one hour before going to work in the morning; in the middle of a long forenoon he should again have water; at noon he should be first watered and then allowed to eat hay for a short time before receiving his grain, which should be given him at least one hour before he is again put to work. In the middle of the afternoon he should be watered again, and in the evening his grain should not be given him until he has first been watered and allowed to eat hay for at least an hour. The trouble and loss of time required to water working animals in the middle of the forenoon and afternoon may, in some cases, render it impracticable, but frequent watering will be found advantageous to the stock in all cases, and a powerful factor in the prevention of colic.

Sudden changes of temperature, unduly severe exertion, parasites (worms, etc.) in the intestines, and feeding on green grass when the animal is not accustomed to it, are frequent causes of colic. Many people imagine that an occasional feed of grass is good for working animals. No greater mistake was ever made, as it is almost sure to d range digestion, induce purging (scouring), and colic which frequently results in death from inflammation of the bowels. An animal from which hard or fast work is expected should never be allowed to eat green grass.

SPASMODIC COLIC.

NATURE.—Spasmodic Colic is a spasmodic contraction (cramp) of a portion of the intestinal walls due to some irritant. This irritant, as before indicated, may be particles of undigested food or foreign bodies. Indiscretions in watering or sudden changes in temperature may also cause the trouble.

SYMPTOMS.—The first and chief symptom of spasmodic colic is a manifestation of pain. An animal that has apparently been in perfect health suddenly stops, paws, looks around at his sides, and perhaps "cringes" or lies down. The pains may soon pass off and the animal again appear well, but after an interval of uncertain duration the pain usually returns with increased severity. As the attack advances the intervals between the paroxysms of pain become of shorter duration and the severity of the pain may increase to such an extent as to render the animal almost wild from his suffering. He will frequently throw himself violently to the ground, roll, and knock himself about in a terrible manner. If the pulse be examined while the animal is suffering from severe pain it will be found faster than normal, perhaps 45 to 60 beats per minute, but with the cessation of the pain it will return to nearly its normal condition, 36 to 40 beats per minute. In this disease, as in many others affecting the digestive organs, the animal may frequently stretch out as if attempting to urinate, and the penis may even be protruded and partially erected, but these are merely manifestations of abdominal pain, and certainly not sufficient to warrant the general opinion that they indicate disease of the urinary organs. Our domestic animals not being so much subjected to mental excitement, nor given to the use of alcoholic stimulants, as are the members of the human family, are as a consequence comparatively free from diseases of the kidneys. Five hundred cases of colic occur to every one case of disease of the urinary organs. Another popular error which may be mentioned in this connection is the belief that if a horse "gives down" when pressure is put over the loins it indicates disease of the kidneys. This is perfectly absurd. If it

indicates anything, even when well marked, it is perhaps evidence of a slightly nervous condition, though nearly all horses whether sick or well, will yield when pinched over the loins. Therefore this "giving down" is absolutely worthless as an indication of disease.

This disease may be distinguished from flatulent (wind) colic by the absence of large quantities of gas in the intestines. The animal is not bloated, that is, the abdominal walls remain undistended. It is most likely to be confounded with inflammation of the bowels, from which it may be distinguished, First: By the fact that in inflammation of the bowels the pain is much less severe, especially in the early stages of the disease. Second: In spasmodic colic the pains come on at intervals, while in inflamation of the bowels it is constant. Third: In inflammation of the bowels the pulse slowly, but constantly, increases in frequency, while in spasmodic colic it remains about normal except during the spasms. Fourth: In inflammation of the bowels the attack is less sudden in its development, and the animal is less violent in his manifestations of pain.

TREATMENT.—Any one of the following prescriptions will be found of service:

1st.	Chloral Hydrate,	1 ounce,
	Sulphate of Atropia,	½ grain,
	Water,	1 pint.
2d.	Sulphuric Ether,	2 ounces,
	Laudanum,	1½ ounces,
	Raw Linseed Oil,	8 ounces.
3d.	Laudanum,	2 ounces,
	Oil of Turpentine,	1½ ounces,
	Raw Linseed Oil,	8 ounces.

Give any one of these at one dose, and repeat in an hour if relief has not been obtained. If the colic is due to portions of undigested food, or to an irritant of any sort in the intestines, a purgative should be given, for which either of the following will serve in nearly all cases:

One ounce of Socotrine aloes dissolved in warm, not boiling, water; or from one to three pints of raw linseed oil. Injections into the rectum are beneficial if properly used. From six to eight quarts of lukewarm water in which has been dissolved a small quantity of good soap is the best material to use as an injection. No violence should be used in inserting the syringe, and especially are all irritants to be avoided. The common practice of in-

troducing tobacco, lumps of salt, etc., etc., into the rectum cannot be too strongly condemned. All violent exercise should be avoided, but gentle movements may help to give relief. The animal should be allowed the freedom of a box stall, or lot, and interfered with only when necessary to prevent him from doing himself injury in the violence of his struggles

FLATULENT COLIC.

NATURE.—Flatulent (wind) colic is recognized by the distention of the intestines with gas resulting from indigestion. It may follow spasmodic colic, or impaction of undigested food in the intestines. but frequently occurs unassociated with either of those conditions.

CAUSES.—The causes of flatulent colic are similar to those named for colic in general, but the feeding of grain immediately before or after severe exertion, and large quantities of green food, are especially liable to cause the trouble.

SYMPTOMS.—Flatulent colic is less sudden in its development than is spasmodic colic. At first the animal may only appear slightly dull, but will soon become somewhat restless, as shown by his pawing, or even lying down. The pain is almost continuous and the pulse gradually increases in frequency; the belly soon becomes enlarged from the formation of gas in the intestines, and gives a drum like sound when struck with the hand. If not relieved, all the symptoms become aggravated and the bloating excessive.

TREATMENT —The treatment of flatulent colic must be on entirely different principles from those followed in spasmodic colic. Opium in any of its forms should be avoided owing to its paralyzing effect on the intestines. The objects to be sought are, First: The relief of pain, Second: The checking of the fermentation and consequent formation of gas, and, Third: The removal of the gas already collected in the intestines. For the first two purposes nothing else has given as good results in my practice as the following:

Chloral Hydrate, - -	1 ounce,
Hyposulphite of Soda, -	2 ounces,
Atropia Sulphate, -	1 grain,
Water, -	8 ounces.

If relief is not obtained from this dose, and the pain is still severe, it may be repeated in from half an hour to an honr; and if the bloating only continues, the hyposulphite of soda alone may be given.

For the removal of the gas which collects in the intestines numerous methods are practiced, and all are of more or less value. Injections into the rectum such as have already been recommended for spasmodic colic are valuable, and may be repeated every half hour until two or three have been given. An injection of four or five ounces of pure glycerine is also of benefit in some cases. One and a half grains each of pilocarpine and eserine, if given by the mouth, or half those quantities if given hypodermically, are held in very high repute by many excellent veterinary practitioners, as they stimulate the action of the bowels and cause the passage of gas by the anus. For the prompt removal of the gas there is no method so effectual and, in my experience so satisfactory, as puncturing the intestines with a small instrument known as the trocar and canula, and made especially for the purpose. This operation looks formidable to the average stock-grower, but a little courage and a strict observance of the following directions will enable him to perform the operation with comparative ease and safety. The horse trocar sold by all dealers in veterinary instruments, and a small knife, are all the instruments required. The most distended portion of the abdominal walls may be selected for the operation, but the favorite location in most cases is on the right side at a point equally distant from the angle of the hip, the border of the last rib, and the extremities of the processes of the lumbar vertebræ (backbone). A small incision about half an inch long should first be made through the skin with the knife, and then by grasping the trocar with the right hand the operator should pass the instrument its full length inwards and downwards into the abdomen, through the opening already made in the skin. The trocar may now be withdrawn while the canula is left in, and if the intestine has been punctured gas will escape. If gas does not flow the instrument should be withdrawn and the direction slightly changed, though there is no need to make a new opening through the skin. If blood flows instead of gas, as rarely happens, the instrument should be allowed to remain in the opening until the flow ceases. The outer rim of the canula should be firmly held by the operator with the thumb and fore finger, and the animal kept as quiet as possible while the instrument is inserted. The instrument should not be left in the opening more than five or ten minutes, but if the gas again collects to such an extent as to cause much suffering to the animal the operation should be repeated. Care should always be taken to have the instrument thoroughly clean. It is a mistake to look upon this operation as a "last resort", for if performed promptly,

that is before the gas has collected to such an extent as to seriously inconvenience the animal, it will be found an effectual means of relief and in few, if any, cases will bad results follow from the operation.

ACUTE INDIGESTION.

What is usually known as acute indigestion is impaction and fermentation of food in the stomach and the formation of gas. It is similar in nature, causation, and symptoms, to flatulent colic. Owing to the fact that the trouble is located chiefly in the stomach instead of the intestines it is more fatal than flatulent colic, and may be distinguished from it by eructations of gas from the mouth (belching). A large part of the gas usually passes back into the intestines and causes their distention as in flatulent colic. The treatment for acute indigestion is the same as for flatulent colic.

INFLAMMATION OF THE BOWELS.

This disease is rare in the horse except as a result of indigestion and colic. As already stated, it may be recognized by the constancy of the pain, elevation of the temperature, and increased frequency of the pulse, together with the general symptoms of disease of the digestive organs. In this disease however, pressure on the abdomen causes the animal to evince pain, and he consequently does not throw himself about in as violent a manner as when affected with colic. Opium in some form is the remedy commonly used in this disease, and morphine, given in from five to ten grain doses every two or three hours, is perhaps the best treatment. Anything like a purgative should be avoided in all cases.

This bulletin has been written solely for the benefit of Mississippi stock owners who, owing to the fact that the services of a competent veterinarian are not to be had except in a few localities, are obliged to treat their own animals.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 26.

SMALL FRUITS.

A. B. McKAY.

AGRICULTURAL COLLEGE, MISS.

AUGUST, 1893.

The bulletins of the Station are sent free of charge to all farmers in this State who apply for them.

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STRAWBERRIES.

The following shows the methods of treatment and the results of experiments with strawberries at this Station.

When the Station was organized at this College, several acres of strawberries were growing on the grounds, and each season since then additional plantings have been made. To determine the character of soil best adapted to this fruit, plantings have been made on high and on low land, on soil varying in fertility and in composition.

While, with proper care, planting may be done at almost any time during the year, and while we have succeeded fairly well with that done during the cloudy, wet spells of summer and during mid winter, we almost invariably secure the best stand, and at the least cost, from plants set as soon after October 1st as the soil is sufficiently moist to put in proper order, and from late February and March plantings. When the weather favors rapid growth from October 1st to December, early fall plantings have given from a third to a half crop the following spring; but this, however, is often accomplished at the expense of a healthy plant growth after the fruiting season. The later the spring planting (if done before plants have become too sappy) the less the tendency to produce fruit, and the greater the tendency to produce vigorous stools and a good crop of young plants.

As the strawberry occupies the same ground from three to five years from the date of planting we find a thorough preparation of the soil at the start, a matter of great importance. The soil, well stirred and pulverized to the depth of twelve to fifteen inches, is thrown into beds or rows four feet apart. On moist level land the rows are finished off so as to leave the plants, when set, from three to five inches above the general level. On high, rolling land, especially if inclined to wash, the rows are harrowed down almost flat. For appearance sake, and to facilitate picking, straight rows are very much to be preferred to; but on hill sides we find it necessary to practice "horizontal cultivation," or circling the rows around the hill, to prevent washing.

While, under favorable circumstances, a strawberry plant simply dropped on the ground will take root and grow, we find it to be good economy to exercise considerable care in transplanting. The rows prepared as above described, a bull-tongue or a light shovel plow is run once or twice along the top of each row to make an opening sufficiently large to receive the plants. During dry, sunny weather the roots are "puddled" or muddied well just before setting. The setters, keeping pretty close to the droppers, spread the roots of each plant out in the furrow somewhat in the same position in which they grew; and, with the hands, sift fine soil in among them, pressing down firm, and leaving the surface between the plants level. Care is taken not to place the crown or center bud below the surface of the ground, as the plants had better be set a little shallow than too deep, especially if in stiff clay which is inclined to run together and pack after rain. The hill or stooling kinds like Wilson and Cumberland are planted twelve to fifteen inches apart in the row; running kinds like Cloud and Hoffman, eighteen to twenty-four inches.

On new beds the straw-like runners on which plants are formed begin to make their appearance early in spring. With such varieties as produce but few runners we usually encourage the multiplication of plants by keeping them trained along the line of the row until a sufficient number of plants are formed to insure a good stand. If the soil is dry the rooting of the plants may be hastened by placing the runners in close contact with the ground and a small quantity of earth around each plant. The question, "Should surplus runners be cut away?" is frequently asked. This depends very much on circumstances. Our practice has been to get the first plants formed well rooted, and covering a space twelve to fifteen inches broad along the line or top of the row, The ideal matted row is one in which the plants covering the space indicated stand one in a place, and each one four or five inches distant from its nearest neighbor, though such a row is seldom seen because of the expense in time and careful labor necessary to perfect it. As will be noticed further on, some varieties do well when permitted to grow very thick in the row, while others must be kept thin in order to produce

healthy plants and paying crops of fruit. During favorable seasons the Michel, for instance, will set something like 1000 plants to a square yard of surface. With such varieties we usually thin more or less at each hoeing, and at the close of the running season (about December 1st.), thin to the desired width. Of course, any plants that form during the running season in the three foot space between the rows are treated like weeds.

In cultivation we use no other tools than those found on every well equipped farm. Work begins on new plantings as soon in spring as ground is in working order. Our usual practice is to begin work by barring off or scraping, in the same manner as the first plowing for young cotton. Hoes follow the plow, taking away any weeds that may be left in the drill. If the ground is sufficiently dry, a bull-tongue or a sub-soil plow (the one-horse Brinley plow with moleboard off is as good as we have ever used), is run in the bottom of the turn-plow furrow, after which a single-horse harrow is run once or twice between the rows. After some days the work of moving the dirt back to the plants begins. For this purpose we find nothing better than the small Brinley plow. Any other small plow, however, that will do good garden work will answer. The sub-soil plow again follows the turning plow, running in the bottom of each furrow as deep as the strength of a good mule will allow. With the soil thus thoroughly broken and finely pulverized between the rows, deep culture ceases for the season. Then the cultivator, sweep, harrow and the hoe are used as often as may be necessary to keep the soil mellow and free from weeds. No set of rules can be closely followed as to the kind and the amount of work required during the season. The soil, the season (wet or dry), and other circumstances, as with other crops, vary the attention needed. We may safely say that, season for season, the amount of hoeing and plowing necessary for the strawberry is not more than double that required for a cotton crop. Usually, very little attention is required from October 15th to the close of picking season. Any weeds or other growth that interferes with the plants during this period is trimmed off with sharp hoes. If the surface soil near the plants be broken ever so slightly during fruiting season a dashing shower of only a few minutes duration will make the

berries sandy for several days following; hence the importance of cutting just above the surface in removing weeds. During the second and succeeding seasons cultivation does not begin until after picking is done, and does not differ materially from that of the first. Our rule is, *Deep and thorough plowing at the start* and *frequent* and *shallow cultivation* for the rest of the season.

For mulching purposes we have found nothing equal to cotton seed hulls. Two and a half to three tons are required to the acre. They can usually be had early in the fall at three and one-half to four dollars per ton. The hulls are put on during February, and are spread on just thick enough to hide the soil well between and around the plants. On the sides of the rows the hulls should extend about four inches beyond the line of the surface covered by plants. Aside from keeping down a growth of weeds and preventing dirt from getting on the fruit, the hulls, in decaying, are constantly feeding the plants with small quantities of potash, a very necessary food for the strawberry.

We look for the first ripe berries about one month (a few days earlier or later according to the variety and the temperature) from the date of the last spring frost sufficiently severe to kill the bloom. The picking period here usually commences in April and continues from one to two and a half months according to the variety, the temperature and the amount and distribution of rainfall during the fruiting season.

The following are among the varieties grown here:

ACME: A plant of medium vigor; easy to preserve a thickly matted row; a little inclined to rust; fruit of medium size, light red, poor quality, and a poor keeper. Not desirable.

BANCROFT: [P.] Large, vigorous plants; few runners; easy to preserve a stand; little or no rust: fruit large, deep red, flavor good, a fairly good shipper; yield heavy.

BELMONT: Plants of medium size; few runners and difficult to keep a good stand; fruit large and of fair quality; color, pale red; keeps well, yield heavy and bears until late in the season.

BUBACH: P] A very vigorous grower; with a fair supply of runners; begins to ripen a little after Cloud and Crescent; continues to give perfectly formed fruit along with the late kinds; size, large; quality very good; color, bright deep red; a good shipper; a variety of fine promise for this latitude both for market and for home use. The plant is almost entirely free from disease of any kind and resists dry weather remarkably well; yield very heavy. Among the best of the late ripening sorts in our collection.

CAPT. JACK: A rather weak grower; foliage a dark, rich green color, but not large enough to protect the bloom and fruit; very few runners; fruit of medium size, conical and almost perfect in shape; rather poor in quality but looks well and ships with the best. Hard to preserve a stand, yield poor; not desirable.

CHARLES DOWNING: Plants of medium size, grow thickly matted in the row; even when left thin the foliage rusts badly; no trouble however to preserve a good stand. Fruit medium to large; pale red color; fairly good in quality but a poor shipper: one of the old varieties of little value.

CHARLESTON: Plants small but vigorous; runners very numerous, and easy to keep a stand. On land of only medium fertility the plants will so completely take possession as to crowd out grass and weeds. If worked thoroughly the first season after planting, or until the plants take possession of the land, this variety will do as well without as with cultivation for two or three seasons. The most satisfactory yields are obtained from thickly matted rows where the ground has not been stirred for one or two years. The matted rows, as described above, and the solid beds standing side by side on the Station grounds show both the quality and the quantity of the fruit to be in favor of the latter. One year in two or three the Charleston beds are renewed by barring off a narrow strip, say six to eight inches wide, filled with plants, between the old rows. If the entire space between the old rows is not sufficiently thick with plants to get a good stand by making the new rows half way between the old, the new rows are made a little to one side of the old.

These are now treated as directed for cultivation of new plantings. Thus in one season the ground becomes re-matted with new plants, and is virtually a new bed. The Charleston is a shy bearer; fruit ripens very early; is of medium size, perfect in shape, uniform in size, a bright polished red, will ship to almost any distance, and rarely fails to bring fancy prices.

CLOUD: [P.] A variety of southern origin; light colored, vigorous foliage; runs freely; rusts badly when allowed to mat too thickly in the row; stands dry weather well; fruit medium to large; dull red color; flavor not the best; although not among the best shippers, it has for several years past been the leading market kind in Mississippi and still deserves a place among the market kinds; yield very heavy.

COMET: A plant of only moderate vigor, runs freely; fruit small to medium, dark red color, quality poor, keeps fairly well; has no special merit with us.

CRESCENT: [P.] One of the standard old varieties; does best in matted rows not too thick; plant dark, rich green color, healthy, very free from rust; runs fairly well; withstands dry weather; fruit medium to large, color rather dull red, quality not the best; ships fairly well; very prolific; during very wet seasons much of the fruit is unsalable; one of the early varieties; deserves a good place in the commercial planting.

CUMBERLAND: One of the stooling varieties; a vigorous, large plant; few runners; stands heat or cold without injury; free from rust; does best on strong land; fruit large, of best quality; pale color, not firm enough to go to distant markets; ripens late and holds on until very late in the season; one of the best for home use and the local market; very prolific.

ECLIPSE: A plant of no special merit. Plant and fruit both poor.

ENHANCE: Large, attractive plant; not a large surplus of runners except on first years plantings; plants set early in fall or latter part of January will produce full half crop the next spring; fruit very large, rich red color, berries solid to the cen-

ter; of very best quality; will ship with Charleston, Bubach and Hoffman; and, because of its large size and other good qualities, usually commands top prices; a late variety; fruit large until the very end of the season. With us the vines give down after the second crop.

EUREKA: [P.] Plants small, thickly set, many runners, easy to hold a stand; fruit small, insipid, poor. Not desirable.

FINCH: A stooling variety; very few runners and hard to keep a stand; fruit medium to large; quality good; color bright red; yield fairly good; ships better than the average; has not maintained the record here that it seems to have won in other parts of the state. Worthy of further trial.

GANDY: Another late variety; strong, vigorous plants, plenty of runners; plants free from disease and remarkably strong the year round; fruit very large, color bright red, quality good, no better shipper in our list; not so prolific as Bubach and Cloud but fruit is nearly all salable; is well adapted to this latitude.

GOLD; [P.] A plant of fairly good habits; fruit small to medium; flavor not the best; color light red; poor keeper; many better kinds in the list.

GYPSY: [P.] Of no special merit here; ranks along with Gold.

HOFFMAN: For several years this has had quite a run in Mississippi; but of late seems to be losing ground; plants rather delicate and tricky; being one of the first early kinds they start into vigorous growth and bloom profusely ahead of other varieties, and a severe late freeze frequently so weakens the plants that they do not recover in time to produce a good crop. Like the Charleston it has its "off" seasons. Fruit medium to large; very bright showy red; very firm regularly shaped berries; one of the best shippers; yield light Toward the end of the season there is usually a second crop of very large berries which bring fancy prices in the local markets.

ITASKA: [P.] Strong, showy plants; many runners; fruit medium size but poor in quality; light yield; possesses a few good points.

IRON CLAD: Plants good size and healthy; few runners; fruit medium size and of fairly good quality; light yield Many better varieties.

JESSIE: A moderately good grower; good stand; enough runners; promises to do something great at the opening of the season but is disappointing; loses nearly all its rank foliage before the fruit crop is set and both fruit and plant dwindle into insignificance before the middle of berry harvest; some good fruit during first pickings.

LADY RUSK: [P] Good stand of small plants; many runners; fruit of medium size, irregular shape and poor quality; nothing to commend it.

LIDA: [P] Plant of above average strength and vigor; good stand and sufficient runners; fruit medium size, dark red color, flavor and keeping qualities not the best; deserves further trial.

MAMMOTH: A fine, strong plant, a little inclined to stool; sufficient runners; fruit small to medium, bright red color; best quality, yield heavy, and a fairly good keeper.

MAY KING: Plants not very strong; few runners; fruit medium size; light red; poor quality; light yield, and a poor keeper.

McNEILL: [P] Origin, Crystal Springs, Miss. A plant of fine traits; large stools, plenty of runners, free from rust; fruit large, regular in shape and size, rich red color; best quality; one of the best keepers; desirable for home use or for market; a late variety.

MICHEL: A remarkably strong plant; withstands heat and cold, wet and dry weather; runners very numerous and continue to multiply on well worked beds from early spring to late in the fall; does best on fairly good soil, in thinly matted rows; rusts badly where plants are thickly matted; fruit ripens with

the earliest and holds on with the latest varieties; on account of its pale, dull color and its rather poor shipping qualities, it does not rank high as a shipper to distant markets; fruit often small and poor early in the season but continues to improve in size, quality and appearance as the season advances. During the past two years most of our fancy local trade has been supplied from this variety. During the last two weeks of the picking season just past the families on the Station grounds ordered the Michel exclusively. A sure but not a heavy bearer; every strawberry grower should plant it.

MRS. CLEVELAND: [P] Plant of average size and vigor; runs freely; is not much affected with rust; fruit of medium size, pale red color, quality only fair; keeps well; yield light; of no special merit.

MONMOUTH: A good, healthy plant; sufficient runners to preserve a nicely matted row; fruit medium size, bright red, best quality, light yield and a fairly good keeper; deserves further trial.

PARRY: Plant weak; stand poor; runners few; yield light; fruit small and poor quality.

PERFECTION: Large, good looking plants but hard to keep a stand; runners few; a light yield of small, poor berries; not desirable.

RUBY: [P] A weak small plant; few runners; light yield of small but fairly good fruit; many better in the list.

SUCKER STATE: A second early variety: plants very strong, showy and healthy; holds its own throughout the year; no large surplus of runners, but usually sufficient for a good stand and to spare; fruit uniform in size and shape, medium to large, light red, good quality, ships well; not the heaviest yield, but a sure cropper; one of the most satisfactory varieties on the grounds.

WARFIELD'S No. 2: [P] A plant resembling the Crescent in color and shape of the leaves, but more inclined to stool; many runners, not subject to rust, easy to preserve a stand; fruit of medium size, conical and perfect in shape, deep red, good quality,

a fair keeper; very prolific; matures its fruit rather late, and nearly all within a few days.

WILSON: Too well known to require description. Like many good things that have been supplanted by better, we remember it for the enviable place it held so long and so deservedly. With good attention it still does fairly well on good land; otherwise it is difficult to preserve a stand and mature a satisfactory yield of good fruit.

WINDSOR CHIEF: [P] Plant of average size and vigor; few runners; not difficult to hold a stand; fruit medium to large, bright red, good quality, and a very satisfactory shipper; yield light; has made a good record in some sections of the State.

VAN DEMAN: A medium size plant with deep green rich colored foliage; runs freely; very free from rust; fruit of medium size, well flavored; very prolific.

[P] placed after the name of a variety above indicates that it is pistillate. The pistillate varieties have few or no stamens in the blooms and must be planted within a few feet of some good staminate variety or in the same rows with them in order to become fruitful.

Crawford, Great Prolific, Manchester, Parker Earle, West Lawn, McMath's No. 2, McMath's No. 3, West Brook, Lanah and Lovett's Early not sufficiently tested to report.

SUMMARY.

The strawberry will adapt itself to and bear some fruit on almost any kind of soil.

At this Station the heaviest yield of good, firm fruit and the healthiest, longest-lived plants are grown on strong yellow clay loam with a deep yellow or orange clay sub soil. Sandy loam with same subsoil as above described, responds most readily to fertilizers and produces earlier fruit but not quite so firm a

berry as the clay loam. Black prairie soil, stiff red clay and light colored, crawfishy land hold a stand but two or three seasons, and produce light crops.

As to location, the summit of a hill or a nearly level valley is preferable to a steep hill side or to a flat, poorly drained bottom soil.

A very rich garden spot or any soil highly charged with humus stimulates a too vigorous plant growth at the expense of a good yield of perfect fruit. In addition to the extra expense of having to "work the plants to death" to keep down weeds on such a soil, here is where the plants first begin to sicken and to die during the long, hot and sometimes very dry summers of this latitude.

Land of medium fertility requires but little, if any, commercial fertilizers. Good results have been obtained from planting cow peas between the rows late in July. Open a deep furrow between the rows, drill in the seed at the rate of one and a half to two bushels per acre, cover with a cultivator or harrow soas to leave the soil in proper shape about the strawberry plants. The shading of the land during August and September, and the vines lying between the rows during the winter months is a decided benefit both to the land and to the strawberries. Properly managed, land in strawberries increases rather than decreases in productiveness. With more or less vegetable matter growing on it during the greater part of the year, and exposed to the sun only a part of the summer, the mechanical condition is being con stantly improved and the vegetable matter plowed in adds fertility.

To renew old plantings where there is a sufficient number of new plants between the rows, proceed as indicated for the Charleston variety; or, on thickly matted rows, just after harvest, with a sharp plow, cut away all the plants except those that will remain within a four to six inch strip along one side of the old row; thin to proper width. and treat as a new planting. By renewing each season in this manner, on choice land, six, and even eight, successive harvests may be made from the same soil before it goes to other crops.

Charleston, Hoffman, Michel, and Crescent are among the earliest varieties; Cloud, Finch, Windsor Chief, Wilson, Sucker State, are midseason; Enhance, Cumberland, Gandy, McNeill, Michel and Bubach are among the latest bearers. Among the best shippers are Charleston, Hoffman, Cloud, Enhance, Bubach, Gandy and Finch. For local market and home use, plant Cumberland, McNeill, Gandy, Enhance, Michel, Bubach and Monmouth.

GOOSEBERRIES AND CURRANTS.

The following varieties have been planted:

GOOSEBERRIES: Downing, Crown Bob, Industry, and Haughton.

CURRANTS: White Grape, Red Dutch, Fay, and Cherry.

Excellent plants were secured, and every attention given in planting and cultivating. Soil was a yellow loam with good clay sub-soil. The first season both gooseberry and currants grew fairly well. At the close of the second season all the currant plants had died and only here and there was there a live gooseberry plant.

RASPBERRIES.

During the fall of 1888 the following named varieties were planted: Handsell, Cuthbert, Orange, Waterloo, Souhegan, Gregg, and Turner's Red. Soil was a dark loam of good strength and located in a valley. Only the Cuthbert and the Turner survived the second season. At the end of the third season only about half a stand remained of these two varieties. Yield was only fairly good. Two years after the first planting the same varieties were planted on a clay loam on the top of a hill. The Cuthbert and the Turner are the only surviving varieties this season. Turner's Red, only 25 per cent. living; Cuthbert, about 50 per cent. of plants survive.

BLACKBERRIES.

Along with the first planting of raspberries and on the same kind of soil, the following named varieties of blackberries were planted:

Kittatinny, Ancient Briton, Wilson's Early, and Lawton.

Of these the Kittatinny and the Lawton are the only ones that deserve mention. Both varieties produced three heavy crops, and, for three years, held a good stand of plants. The last two seasons (1892 and 1893) the red rust has well nigh destroyed them. In 1890 this list of varieties, with Wilson Jr. and Lucretia, were planted by the hill planting of raspberries. Result, the same as on first planting. Lucretia is, so far, free from rust and has borne one heavy crop.

MISSISSIPPI

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EXPERIMENT STATION.

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Insecticides and their Application.

HOWARD EVARTS WEED.

AGRICULTURAL COLLEGE, MISS.

NOVEMBER, 1893.

The bulletins of the Station are sent free of charge to all farmers in this State who apply for them.

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INSECTICIDES AND THEIR APPLICATION.

Standard Insecticides.

Insecticides are substances used to kill insects. They may be poisonous chemical compounds, such as Paris green, or more simple substances, such as tobacco or hot water. The term "standard" is used to designate the well known substances used as insecticides in distinction to many special preparations to be spoken of later.

Insecticides may be divided into two general classes: (1) those which kill by external contact; and (2) those which kill as an internal poison. The first, or external contact class, are applied directly to the insects and may kill by closing the breathing pores or by producing an irritation of the skin. The second, or internal poisons, are applied to the leaves upon which the insects feed, and kill by being taken into the alimentary system when portions of the leaves are eaten. Some substances may act both as external irritants and internal poisons, thus belonging to both classes.

Insects destroy plants in two ways: (1) by sucking the juices; and (2) by eating the leaves, depending on whether their mouth parts are formed for sucking or for biting. The sucking insects have the various parts which go to make up the mouth formed into a beak, through which the plant juices are sucked up, and are known as the *Haustelate insects*. The biting insects, on the other hand, have more distinct mouth parts, provided with two more or less developed jaws or mandibles, by means of which small particles of the leaves are eaten off and taken into the alimentary system, and are known as the *Mandibulate insects*.

Insecticides of the external contact class are used for the haustelate insects, and the internal poisons for the mandibulate insects. Sometimes, however, it may be convenient to apply the external contact insecticides to the mandibulate insects; but the internal poisons are never applied to haustelate insects. Thus, for example, it may be convenient to use kerosene, an external irritant, to kill the green worm upon the cabbage, which is a mandibulate larva; while, on the other hand, the application of Paris green, an internal poison, to the Harlequin Cabbage Bug, a haustelate insect, would be of no effect. We thus see that it is important that we know whether any insect which we may wish to destroy is a haustelate or mandibulate insect, and knowing the food habits of an insect will greatly aid us in deciding which insecticide will best destroy it.

PARIS GREEN is an arsenite of copper, and contains about fifty-five per cent of arsenic. It belongs to the internal poison class of insecticides and is probably more generally used than is any other insecticide. It retails at about thirty-five cents per pound, but can be had much cheaper if purchased in large amounts.

LONDON PURPLE is an arsenite of lime, a by-product in the manufacture of analine dyes, placed upon the market by the Hemingway London Purple Co., London, England. Its action is about the same as that of Paris green and it contains about the same amount of arsenic. It retails at about seventeen cents per pound and in large amounts at twelve cents. For general use there is but little difference in results between Paris green and London purple, in our experience however, preference is given to the former.

Paris green and London purple are known as the *arsenites*, and are used either in a dry form or mixed with water for all mandibulate insects. When used in a dry form they can be mixed with flour or lime to advantage in many cases, their effectiveness, when used in this way, depending not so much on the amount used as on the evenness of their distribution. The arsenites are practically insoluble in water, the particles remaining suspended. Nor is it desirable that they should be soluble, for if such were the case they could not be applied to plants, owing to damage to foliage. When mixed in water the proportion generally used is about one pound of arsenic to 200 gallons of water, or about a tablespoonful to the pailful, and if evenly applied, one pound to 300 gallons is usually sufficient. If applied in too strong a proportion damage to the foliage is apt to result. Some foliage, such as the peach, is much more susceptible to damage than other foliage, such as the apple, and when leaves are young they are not so apt to be damaged as when fully developed. Damage to foliage, however, can be entirely prevented by the addition of a little lime to the mixture, when used in the above proportions, and whenever damage is feared this should be done. In mixing the arsenites it is best to add only enough water to form a thick paste with the powder and then add water sufficient to dilute as may be desired.

PYRETHRUM is an insecticide belonging to the external class, and is made by powdering the leaves and flowers of the pyrethrum plant, which is extensively grown in Persia and California, and will grow fairly well in the southern states. The pyrethrum grown in California is known as "Buhach," and is a better product than the Persian Insect Powder, or the pyrethrum grown in Persia. The Persian product is probably diluted

to make it cheaper before reaching our markets. Pyrethrum is a perfectly harmless powder and is not poisonous in any way, and hence is useful to apply to plants where we do not wish to apply any poison. It may be applied in a dry form or mixed with water, although preference is given to its application in a dry form. It is used quite extensively for cabbage worms and plant-lice. The varying results reported by different persons in the use of pyrethrum is no doubt owing to the difference in its quality, as it seems to lose its strength to a certain degree upon exposure to the atmosphere. The Persian Insect Powder can be obtained at drug stores for thirty-five cents per pound, while Buhach sells for about seventy-five cents per pound. Druggists, in purchasing their supply, had best get it from importers or manufacturers rather than their wholesale drug house. It can be obtained from the following supply houses: Buhach Producing Co., Stockton, Cal.; Leggett & Bros., 301 Pearl St., New York; and Thomas Woodason, 451 E. Cambria St., Philadelphia, Pa.

Tobacco is an insecticide, the merits of which are often underrated. It belongs to the external class, and is especially useful against plant-lice. Refuse tobacco can be obtained at but little cost, and for fumigation in green houses it has no superior. A small quantity should be put in an iron or tin vessel in the center of the green house and the tobacco fired by means of a few coals. It will burn slowly, giving off its deadly fumes, and in the course of a few hours the plant-lice in the green house will be effectually destroyed. The tobacco can be made into a decoction by boiling a quantity in water, and if this is done at the beginning of the season it can be kept on hand in large amounts for use whenever needed. The decoction is also an excellent wash for domestic animals when troubled with lice.

White Hellebore is a vegetable poison made from the roots of *Veratrum album*. It is both an external irritant and an internal poison. It is applied in the same manner as pyrethrum and is especially used upon a family of insects known as the saw-flies.

Kerosene is the most useful of the external class of insecticides, but it cannot be applied in a pure state, owing to the fact of its damage to foliage. It has heretofore been made into an emulsion by first mixing with soap suds and then diluting with water to any extent desired, which is best from one-tenth to one-fifteenth. In this proportion damage to foliage is prevented, but owing to the penetrating qualities of the kerosene, the insects are destroyed. The emulsion can also be made, and many prefer the method, by mixing two parts of kerosene with one part of sour milk and then diluting with water to the extent desired. The details as to the proper making of an emulsion, however,

need not be stated here as it is probable that in the future we will depend upon the mechanical mixture of kerosene with water to accomplish dilution.

HOT WATER would be an excellent insecticide were it not for the fact that the water cools very rapidly when applied in the form of a spray. It can, however, be applied to advantage in many cases.

BISULFIDE OF CARBON is a volatile liquid, the fumes of which are very destructive to animal life, hence it is of great use in the destruction of many insects which cannot be reached by other insecticides. It is especially used in the treatment of insects in the granary. These do much damage to the grain interests, yet can be killed very easily by the use of this substance. In the treatment of grain insects the grain should be put in a tight bin or crib and the bisulfide simply poured over the top. The quantity necessary will depend upon the tightness of the bin, an ounce of bisulfide to the hundred pounds of grain generally being sufficient. The bisulfide is best obtained direct from the manufacturer, Edward R. Taylor, Chemist, Cleveland, Ohio, who sells it in fifty pound lots at ten cents per pound. If bought from the druggist it will cost from twenty to sixty cents per pound. The fumes are explosive and hence it should not be brought near a fire. It is also excellent in destroying ants and for this purpose a small amount is placed in a hole made in the ant hill and then touched off with a match. While it is not necessary that it should be lighted yet it will be more effective if this is done.

Special Preparations as Insecticides.

For some time past the Station has been making tests of many of the so-called patent insecticides, with a view both as to their effectiveness in destroying insect life, and their relative value in comparison with the standard insecticides. These substances are, as a rule, patented only so far as the registration of their trade name answers this purpose. Their composition, however, is only in a very few cases given to the public. It has been our endeavor to give these substances a fair trial and if any have merits we do not hesitate to recommend them. The composition of these substances is given below in a general way and in this work the Station Chemist has rendered aid.

A perusal of the list given below shows that, while in some special cases a few of the patent insecticides have much merit, the standard insecticides and their combinations generally have all the merits claimed for these special preparations. Many of

the latter, indeed, are simply combinations of the standard insecticides and are sold at an immense profit, so that in many cases the buyer pays a high price for the simple mixing of two or more of the standard insecticides. Most of these special preparations have been tried upon cabbage insects, these being more common with us than any others. These include especially the Imported Cabbage-worm (*Pieris rapæ*), the Native Cabbage-worm (*P. protodice*), the Cabbage Plusia (*Plusia brassicæ*), and the Cabbage Aphis (*Aphis brassicæ*).

No attempt has been made in the following list to include all the special preparations sold as insecticides, but only a few of the many upon the market which have come under our observation. Thanks are due to the manufacturers for furnishing trial samples. The Station is prepared to give the subject further attention and manufacturers are invited to send us samples of their preparations for trial. Such trial will, no doubt, show many to be of but little value, but on the whole will accomplish good in bringing forward any substance which may have merits.

Campbell's Lemon Oil Insecticide is a combination of lemon soap and oil of bergamont, sold by J. J. Pollexfen, Homeland, Md., at two dollars per gallon. It acts externally, and we have found it effective against fleas upon dogs, and plant lice upon the cabbage and grape. Upon the Imported and Native Cabbage-worms and the Cabbage Plusia it has no effect. It does not injure foliage when diluted with from five to twelve parts of water, as directed.

Campbell's Fumigating Insecticide consists of corrugated paper, to which is added a small amount of volatile oil. As its name implies, it is used for fumigation in green houses; a No. 1 roll sufficing for 1,000 square feet, selling for fifteen cents; and a No. 2 roll sufficing for 2,000 square feet, selling for twenty-five cents. The form in which it is put up makes it very convenient, and it is effective for the purpose designed. It is for sale by J. J. Pollexfen.

Par' Oidium, or black sulfur, is said to be a combined fungicide and insecticide, and is for sale by F. C. Boucher & Co., St. Paul, Minn., at thirty cents per pound. We have not tested its merits as a fungicide, but have been unable to find it of any value as an insecticide, though it was thoroughly tested upon the Grape and Cabbage Aphides and the Cabbage worms, both in a dry form and mixed with water. It does not mix readily with water and does no damage to foliage when used in the proportion directed. In composition it consists of sulfide of iron with a small amount of hydrocyanic acid.

SLUDGITE is prepared from sludge, a petroleum extract, combined with soap, and is sold by the Columbia Chemical Co., Brooklyn, N. Y., at a dollar per six pound can. It does not dissolve readily except in very hot water, which is an objection to its use. It is quite concentrated, disagreeable to handle, and when used is dissolved and mixed with a large amount of water. Its action is external and we have found it effective against the Cabbage worms and Aphis, but its action is not sufficient to recommend its use.

SPANISH PINK is for sale by Leggett & Bro., 301 Pearl St., New York, at about twenty cents per pound, or in fifty pound cases at twelve cents per pound. It consists mainly of pyrethrum, with the addition of an iron coloring matter, and its action is about the same as that of pyrethrum.

THE ORIENTAL INSECTICIDE is sold by Bigelow & Co., 716 Larrabee St., Chicago, at seventy-five cents a gallon. It is a liquid, quite similar to Campbell's Lemon Oil Insecticide, and although "guaranteed to destroy any insect that feeds upon vegetation," we have thus far failed in our efforts to find it of any practical value. It is diluted with water when used, and unless quite dilute, damage to foliage will result. We have obtained only negative results in its use against the Imported and Native Cabbage worms, Cabbage Plusia, Harlequin Cabbage-bug, and the Negro-bug (*Corimelæna atra*). Even with the Cabbage Aphis its action is uncertain, and this, together with the fact that its damage to foliage is quite marked unless used with great care, makes it of little value as an insecticide.

MUELLER'S BUGICIDE is placed upon the market by the Bugicide Manufacturing Co., La Crosse, Wis., in half pound cans at fifty cents per can. It is composed of pyrethrum, to which is added a small amount of naphthaline, and is very useful to destroy bed bugs and cockroaches.

ANTINONNIN is a substance said to be largely used as an insecticide in Europe with great success. It is manufactured in Germany and sold in this country by W. H. Schieffeln & Co., 170 William St., New York. It is a semi-solid substance of a reddish-yellow color, resembling somewhat the red lead used in the arts, and is composed largely of alizarin orange. It is dissolved in water when used, and stains the hands and clothing to such an extent as to make it very disagreeable, and does great damage to foliage unless diluted to a very large extent. Used against plant-lice and Cabbage worms we have been unable to find it of any value whatever.

INSECTICENE is an emulsion of carbolic acid sold by the Correct Remedy Co., Dayton, Ohio. It belongs to the external class

of insecticides and is effective against Cabbage worms and plant-lice, but great care has to be taken in its application and proper dilution to prevent damage to foliage. Used as a wash for domestic animals and poultry houses to destroy lice and ticks, it is good.

THYMO-CRESOL is apparently a crude form of carbolic acid. It is sold by Lawford Bros., P. O. Box 584, Baltimore, Md., at twenty-five cents per four ounce bottle, or two dollars per gallon. It is quite concentrated, however, and for use is diluted with from twenty to one hundred and fifty parts of water, making it a cheap application. It is not intended as a general insecticide, but as sheep dip and a wash for domestic animals it has proved an excellent article.

W. S. Powell & Co., of Baltimore, Md., are large manufacturers of commercial fertilizers and place upon the market also several insecticides. Among these we have tested the following:

POWELL'S CARBOLIZED SOAP is, as its name implies, a mixture of carbolic acid and soap. It sells at a dollar per gallon and is diluted with water when used. We have found it useful against plant-lice and as a wash for domestic animals, but it has no effect upon cabbage worms.

POWELL'S GUICIDE POWDER is sold in five pound packages at eight cents per pound. It is an arsenite of copper mixed with lime or marl, with a slight amount of carbolic acid. It acts as an internal poison and has been found effective against the Cabbage worms. It is slow in its effects however, and is not so good as Paris green.

POWELL'S QUASSAINE is "a concentrated fluid extract of quassia, held in suspension by whale oil soap." It is external in its action and has proved effective against the Cabbage Aphis, but without effect against the Cabbage worms. It is sold at a dollar and fifty cents per gallon and diluted largely when used.

Probably the largest manufacturer of special insecticides in this country is Benjamin Hammond, Fishkill-on-Hudson, New York. Those which we have tested are as follows:

HAMMOND'S SLUG SHOT has probably been more largely advertised than has any other special preparation as an insecticide. It has been upon the market for several years, being especially used against the potato beetle. It is in the form of a fine powder and is a compound of lime, arsenic, and sulfuric acid, and retails at about five cents per pound. We have found it effective against the Cabbage worms but in this respect it is not the equal of Paris green.

HAMMOND'S TOBACCO EXTRACT is simply a concentrated extract of tobacco made by boiling tobacco in water. It acts as an external irritant, and is especially useful against plant-lice. Retails at a dollar per pound.

HAMMOND'S THRIP JUICE is a compound of resin soap and retails at about a dollar and twenty-five cents per gallon. It may be diluted largely and is useful against scale insects and plant-lice. Thrip juice No. 1 contains arsenic and hence acts as an internal poison, as well as an external irritant.

HAMMOND'S SCROFULARIA POWDER is a compound of pyrethrum and camphor. It is useful in the same manner and for the same purposes as Mueller's Bugicide, and is sold at fifty cents per half pound.

Apparatus for the Application of Insecticides.

In connection with our trials of special preparations as insecticides, we have also tested a number of spray pumps and other apparatus for the distribution of insecticides. Special interest has been taken in any new apparatus for this purpose, and in that which follows mention is made only of that which we have personally tested, believing that in this manner any opinion which may be expressed as to the value of any apparatus will have greater value. This is also true of the nozzles mentioned, in which, however, our list is more complete. There being so many machines for the application of insecticides upon the market, no attempt has been made to obtain them all, but rather one pump from each of the principal manufacturers which might, to a certain extent, be taken as a representative apparatus. In this our thanks are due to the manufacturers who, in many cases, sent their pumps, nozzles, and electrotypes to the Station. Just as any two persons may differ as to the value of any article, so they may think differently as to the merits of any of the machines or nozzles described below.

The principal manufacturers of a general line of spray pumps are: The Deming Co., Salem, Ohio; The Goulds Manufacturing Co., Seneca Falls, N. Y.; Rumsey & Co., Seneca Falls, N. Y.; W. & B. Douglas, Middleton, Conn.; F. E. Myers & Bro., Ashland, Ohio; The Nixon Nozzle and Machine Co., Dayton, Ohio; and the Field Force Pump Co., Lockport, N. Y., and it will pay those interested to send for the catalogues of these firms. The other pump manufacturers, as a rule, manufacture but one pump of their own design, but have for sale also many of the pumps manufactured by the above named firms, but under different names.

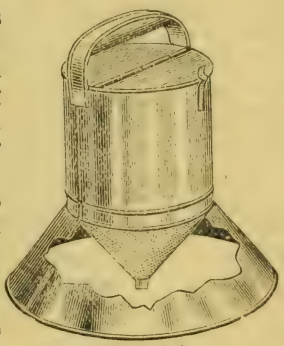
The Distribution of Dry Insecticides.

Apparatus for the distribution of insecticides in a dry form should be easily handled, durable, and arranged to distribute either a fine or a coarse powder.

Woodason's Bellows are good distributors upon a small scale. They are manufactured by Thomas Woodason, 451 E. Cambria St., Philadelphia, and vary in price according to size. The largest, a double cone bellows, sells at three dollars, while a smaller one (Fig. 1) a single cone bellows, sells for one dollar.

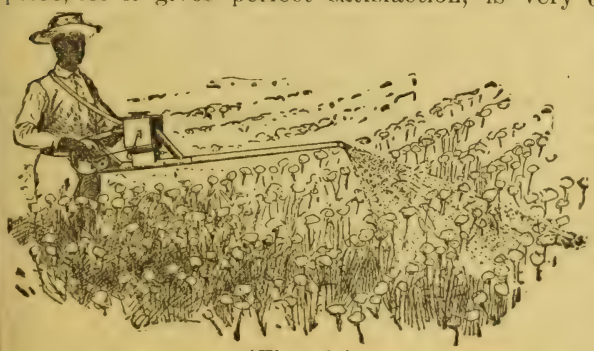
[Fig. 1.]

Norton's Plant Duster (Fig. 2) is convenient for use where only a small number of plants are to be treated, and is manufactured by the Troy Stamping Works, Troy, N. Y. It is made of tin with a sieve at the bottom, and retails for one dollar.



[Fig. 2.]

Leggett's Dry Poison Gun (Fig. 3) is by far the best apparatus we have found for the distribution of dry insecticides. It is sold by Leggett & Bro., 301 Pearl St., New York, for nine and a half dollars. While more costly than some of the other machines, yet it is well worth its price, for it gives perfect satisfaction, is very durable, easily handled, and arranged so that a large or a small amount of any dry powder can be distributed. It is operated by turning a crank which blows the powder out through a tube. By means of extension tubes and a ground rest the powder can also be distributed upon trees.



[Fig. 3.]

The Cyclone Machine (Fig 4), manufactured by the Hotchkiss and Tuttle Co., Wallingford, Conn., is of much less value. In its principle of construction it is similar to the Leggett Gun, but does not give the satisfaction given by the latter. It is heavier, not so easily handled, and is designed to distribute only pure Paris green and will not work with other dry powders. The price is six dollars.

[Fig. 4.]

The Roach Poison Distributor is manufactured by J. P. Roach, Vicksburg, Miss., and is the best machine for use on a large scale, being especially useful in the distribution of dry poisons upon cotton plants. Although the price of this machine is about sixty dollars, it will pay well upon large cotton plantations to purchase it. The insecticide is placed in a large receptacle with a tube leading from it through which the insecticide is distribed over several rows at a time. By means of an attachment to the wheels, the machine requires no labor in its operation other than driving the team.

The Dry Poison Duster is an apparatus which is simple in its construction and was designed especially for applying Paris green to cotton. It consists simply of two bags made of eight ounce osanburg attached to the ends of a pole about six feet long and two inches in diameter—a hickory pole being preferred. The bags are made about a foot long and six inches deep and are tacked to the sides of the pole. The dry insecticide is placed within the bags by means of a hole about an inch in diameter, bored through the pole, to be stopped up with removable plug. For cotton plants this apparatus is operated by holding in the hands when upon a mule. If the mule goes at a brisk trot the poison will be distributed evenly and rapidly. For other plants, such as the cabbage and potato, the apparatus may be held in the hand and shaken.

The Distribution of Liquid Insecticides.

Insecticides may be applied when in a liquid form by means of pumps of varying designs and styles. There are, however, five forms of these pumps which may be designated in a general way as gravity, knapsack, hand, field, and automatic power pumps.

A pump, to be satisfactory, should throw a continuous stream with considerable force, and for this purpose must be provided with an air chamber. While cost is a large item in the purchase of a pump, yet it should be durable and as a rule the cheaper pumps lack this quality. An important point in the make up of a pump is an agitator, by means of which the liquid is kept well stirred, and this is generally provided for by having a discharge

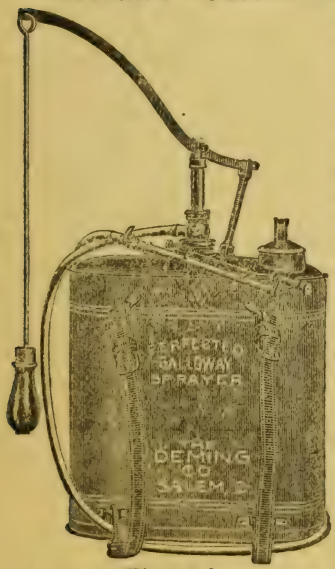
pipe, by means of which a part of the liquid is pumped back into itself. The knapsack pumps, however, do not need this agitator, as the motion of a person carrying the pump is sufficient to keep the liquid stirred. The nozzle is an important part of a pump, and the different styles are explained later.

GRAVITY PUMPS.—These are not pumps properly speaking, but simply sprinklers which depend upon the action of gravity for their operation. They are very unsatfactory, and although sold at a low price, it will not pay to purchase them, as common watering pails will do the work equally well. Of this form we have tested the two following:

Norton's Improved Sprinkler is manufactured by the Troy Stamping Works, Troy, N. Y., selling at three and a half dollars. It consists of a small reservoir attached to the side of the body by means of straps.

The Boss Sprinkler is manufactured by Oliver A. Smith, Clarkston, Mich., selling at three and a half dollars. It is very similar to the above, except that the reservoir is attached to the back like the knapsack pumps, and by this it is more easily handled.

KNAPSACK PUMPS.—This is the most satisfactory style of pumps for general purposes, especially for garden and vineyard work. They consist of a pump placed within a reservoir to be carried upon the back, and attached to the shoulders by means of straps. The reservoir is made of different sizes, from four to six gallon capacity, the five gallon size being probably the best for general purposes. The reservoir should be made of copper, so that it will not corrode in the application of Bordeaux Mixture, a fungicide used in the treatment of grape and other diseases.



[Fig. 5.]

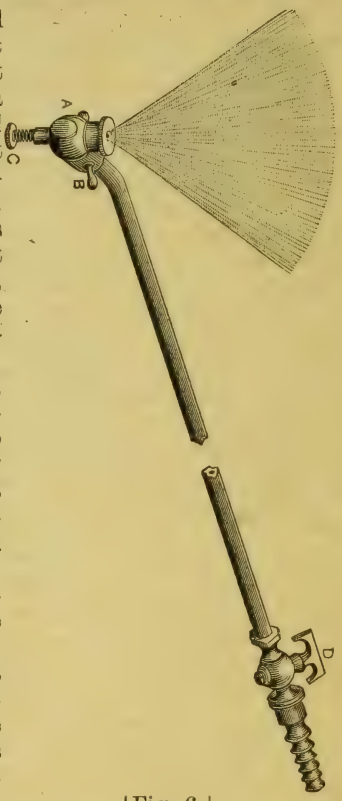
Of the Knapsack pumps we have tested the two following, which are probably the best upon the market.

The Perfected Galloway Sprayer (Fig. 5) is a modification of a pattern designed by Mr. B. T. Galloway of the United States Department of Agriculture, manufactured by the Deming Co., Salem, O., and selling at fifteen dollars. The reservoir is of five gallon capacity, and the pump is considerably improv-

ed over the original Galloway pattern. It is arranged so that the pumping can be done with either hand and the pump can be readily removed from the reservoir, an important point in its favor. The pump is fitted with the Deming nozzle and has given us perfect satisfaction.

The Eureka Knapsack is placed upon the market by Wm. Boekel & Co., 518 Vine St., Philadelphia, at sixteen dollars. It is made with a reservoir capacity of six gallons and has long been known as an excellent pump, being probably the first knapsack manufactured in this country. A great advantage of this pump is that it has a large air chamber so that it will keep up a continuous spray, even though the pumping may be stopped for a short time. It is provided with the Vermorel nozzle.

In spraying many garden crops, such as the cabbage, it is quite important to have an undersprayer so that the underside of the leaves may sprayed. Both the above knapsacks have such attachments, the undersprayer for the Eureka being shown in Fig. 6.

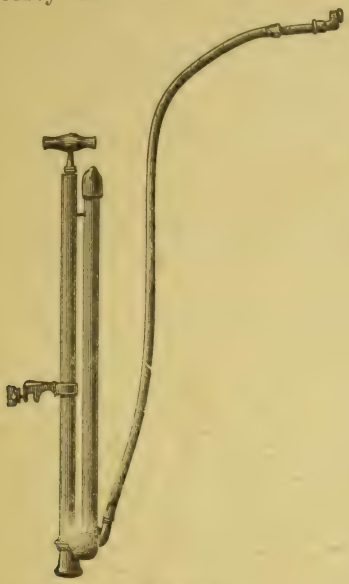


[Fig. 6.]

Hand Pumps.—These are of several styles, most of which are made to be attached to a water bucket. They do very good work where it is not desired to go over a large orchard or field, and for greenhouse work, or for spraying a few trees they are excellent, but are not desirable for vineyard work. This style of pump is also useful for many purposes other than spraying, for by changing the nozzle, either a solid stream or spray may be thrown, thus making the pumps convenient in washing buggies or as fire extinguishers.

The Myers Bucket Spray Pump (Fig. 7), manufactured by F. E. Myers & Bro., Ashland, Ohio, for six dollars, is one of the best of the hand pumps. It is made of brass, fitted with the Myers nozzle, and constructed so that the force is obtained on the down stroke of the plunger; thus avoiding the necessity of keeping the pump in position with the foot. It is provided

with an agitator and has force enough to throw a stream fully forty feet.



[Fig. 7.]

[Fig. 8.]

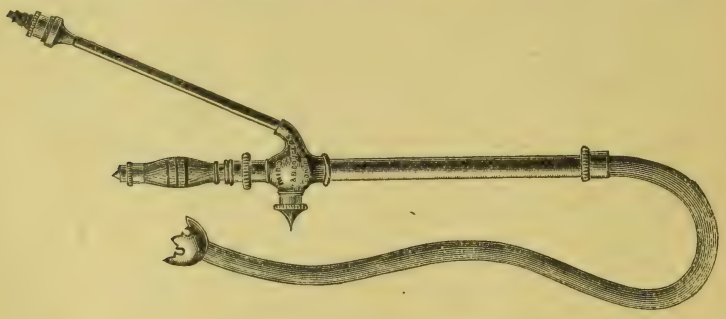
The Little Gem (Fig. 8) is similar to the above and manufactured by the Field Force Pump Co., Lockport, N. Y., at four and a half dollars. It is constructed of brass and fitted with the Vermorel nozzle. When attached to a water bucket the pump is held in place with the foot, as shown in the figure.

The Aquaject is similar to the two above mentioned pumps, manufactured by Rumsey & Co., Seneca Falls, N. Y., at nine dollars. We have had this pump in use at the Station for several years, and while it has given satisfaction, it is more costly and we do not regard it as being any better than the two pumps mentioned above.

[Fig. 9.]

The Hydronette (Fig. 9), sold by Rumsey & Co., for eight

dollars, is another style of hand pump, and where ease in carrying is considered, it is probably the best style. It throws a good stream, is easily worked, and being fitted with the Lilly nozzle, will throw either solid stream or spray as desired.



[Fig. 10.]

The Double Acting Aquanette (Fig. 10), manufactured by W. & B. Douglas, Middleton, Conn., at nine dollars, is similar to the Hydronette except that it is arranged to throw a continuous stream. The Douglas Company also manufacture the Single Acting Aquanette, at eight dollars, which is practically the same as Rumsey's Hydronette. We regard the single acting Aquanette as more satisfactory than the Double Acting design, both of which are fitted with the Pilter-Bourdil nozzle.

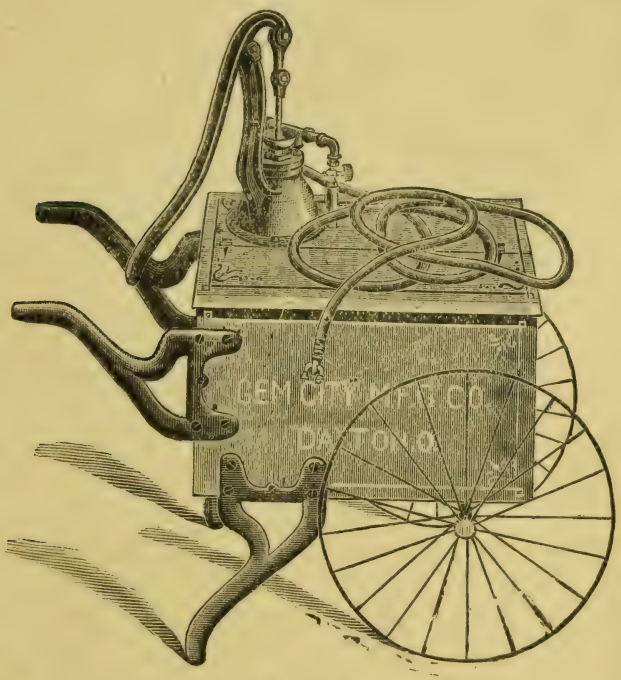
[Fig. 11.]

The Victor Spray Pump, manufactured by Henion & Hubbell, 55 N. Clinton St., Chicago, while novel in design, is not to be recommended for general use, as it is too cheaply made to be durable and satisfactory.

Field Pumps.—By field pumps is meant the style of pumps used in spraying large orchards or fields. There are many of these, some being made to be attached to a barrel to contain the liquid to be sprayed, while others are furnished with reservoirs placed upon wheels. Of the many upon the market, we have tested the following:

The Wonder Spray Pump (Fig. 11), manufactured by the P G. Lewis Manufacturing Co., Catskill, N. Y., for six dollars,

is an improved modification of the Lewis Combination Pump, which has been upon the market for several years. While perhaps more properly classed with the hand pumps, yet it is also adapted for spraying orchards by placing it in a barrel, as shown in the illustration. It answers the purpose of both a hand and field pump fairly well. The pump is made of brass and consists of three parts, one of which is intended as a veterinary syringe.

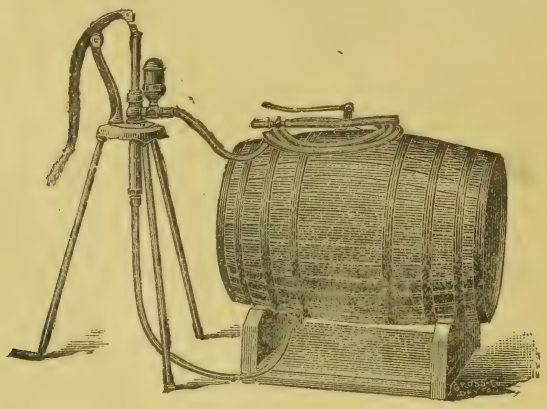


[Fig. 12.]

The Peerless Spray Pump (Fig. 12), manufactured by the Gem City Manufacturing Co., Dayton, Ohio, at twenty dollars, is one of the best outfits of the kind for the price. The illustration shows the nature of this pump so that but few words are necessary in its description. The pump is provided with a large air chamber, giving a forcible and continuous stream, and has an agitator of very novel construction, by means of which the spraying liquid is kept thoroughly stirred. While this pump was designed and is especially useful for the application of disinfectants

and kerosene mixed directly with water, it is also excellent for orchard work. It is provided with the Invincible nozzle.

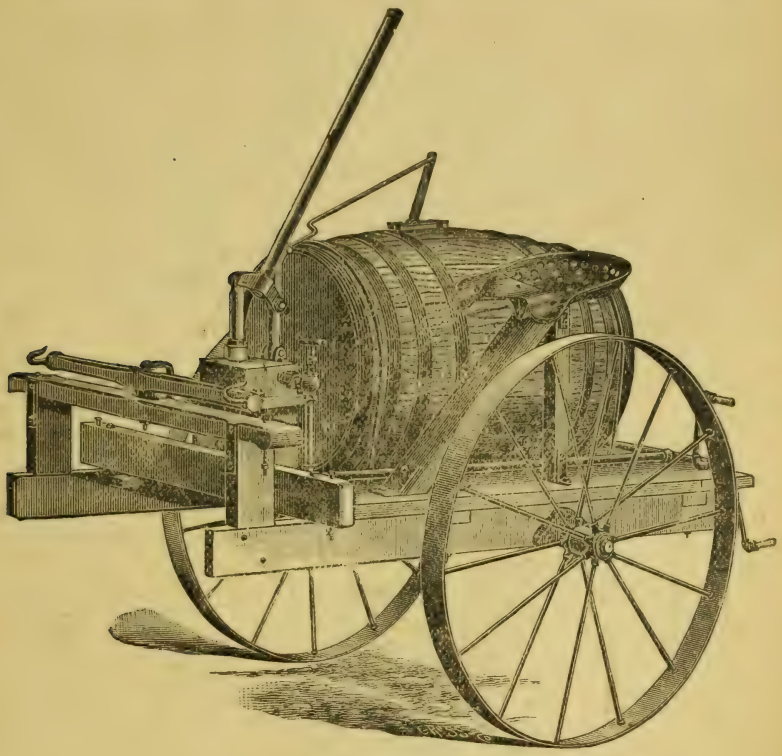
The same Company also manufacture another pump known as *Outfit Number Four*, the price of which is four dollars, which consists of a pump placed within a reservoir of eight gallon capacity. The pump of this outfit is very good, but the tank is poor and not easily handled, making the outfit of no special value.



[Fig. 13.]

The Climax Pumps (Fig. 13) are manufactured by the Nixon Nozzle & Machine Co., Dayton, Ohio, costing ten, fifteen, and twenty dollars, according to size. They may be placed upon a tripod, as shown in the illustration, or the legs of the tripod may be taken off and the pump placed upon a barrel. We have found that these pumps do excellent work and are very desirable for orchard work. They are fitted with the Climax nozzle.

Automatic Power Pumps.—In this style of spraying machines the force necessary to run the pump is obtained by means of gearing attached to the wheels of the machine, and the accompanying illustration (Fig. 14) shows the general nature of this style of machine. They cost from fifty to ninety dollars and are only desirable in spraying on a very large scale. Various styles are manufactured by the Nixon Company and the Field Force Pump Company.



[Fig. 14.]

Extension Rods.

Various devices are arranged whereby the tops of trees may be sprayed from the ground by means of extension rods. In spraying orchards with the field pumps these rods are not necessary except with very tall trees, but the rods are often convenient in spraying large trees with the knapsack or hand pumps. These are furnished by most of the pump manufacturers at a little additional cost. Fig. 15, on the next page, shows the Myers extension pipe which is furnished, eight feet long, for sixty cents.

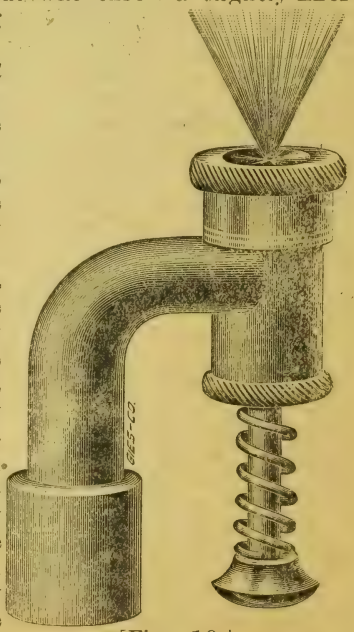
[Fig. 15.]

Nozzles.

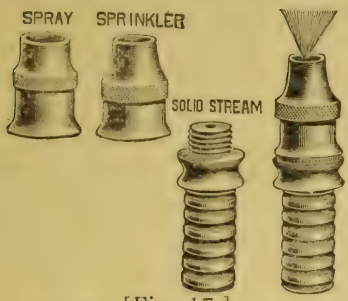
The nozzle is an important point to be looked after in the selection of a spray pump. A good nozzle should throw a fine spray with considerable force, and be so arranged that it will not clog. It is also a convenience if the nozzle can be changed from a solid stream to spray without trouble. Of the many nozzles upon the market we have tested the following and, although the nozzles have different values for various kinds of work, to show what we consider their relative worth, they have been arranged in order of value, beginning with the best. The nozzles are furnished with the pumps manufactured by the companies named, and when purchased separately, can be had for from one to one and a half dollars.

The Deming (Fig. 5) is essentially the same as the Vermorel, but will throw a slightly finer spray. The Deming Company.

The Vermorel (Fig. 16) is an improvement over the cyclone pattern, and in its various styles is by far the most satisfactory nozzle for the general purposes of a spray nozzle. The main advantages of this are that the spray is thrown as a very fine mist, by means of a degorger, any clogging can be instantly remedied, and the spray is thrown in the form of a circle. It is for sale by nearly all of the pump manufacturers. With the knapsack pumps it is quite important to have



[Fig. 16.]

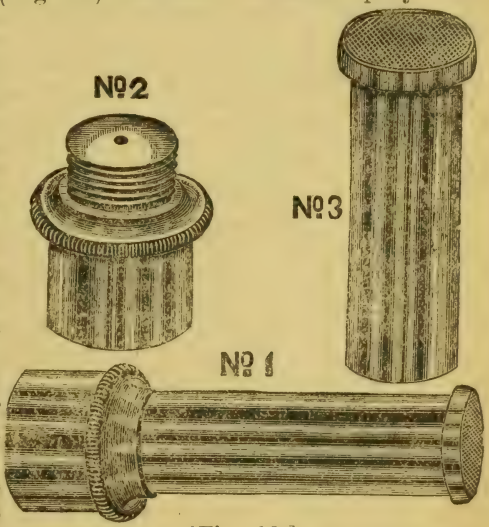


[Fig. 17.]

this nozzle, although it is not so well adapted in spraying orchards as either the Nixon or Lilly nozzle.

The Myers (Fig. 17) throws a circular spray and is equal to the Vermorel so far as the fineness of the spray is concerned, but is more apt to clog if a little dirt gets into it. It is very convenient in that it can be changed from spray to solid stream by unscrewing the outer part. F. E. Myers & Bro.

The Nixon Nozzle (Fig. 18) throws a circular spray with great force and is perhaps better adapted for orchard work than either of the foregoing. A solid stream is obtained by unscrewing the outer part as in Nos. 2 and 3 in the illustration. The Nixon Nozzle & Machine Co.

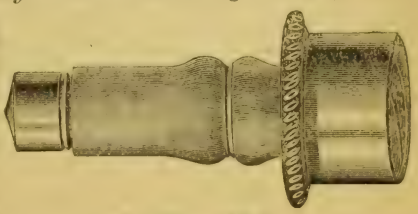


[Fig. 18.]

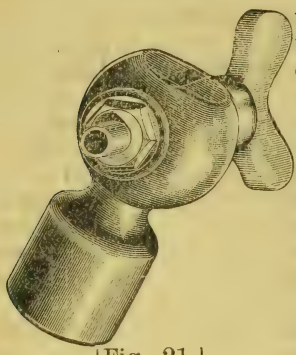
The Pilter-Bourdil (Figs. 19 and 20) is a French invention of novel design. The discharge is lateral and the pressure against rubber bands covering the holes causes the bands to give way sufficiently to cause a circular fine spray. W. & B. Douglas.

[Fig. 19.]

The Lilly is of neat design and can be readily changed from solid stream to a fine or coarse spray, as desired. It throws



[Fig. 20.]

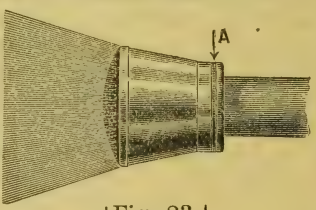


[Fig. 21.]

the spray considerable distance and on this account is especially adapted to orchard work. Rumsey & Co.

The Masson (Fig. 21) throws from a solid stream to a very fine mist, at the will of the operator. While the spray can be thrown as fine as with the Vermorel, yet the spray is fan shaped instead of circular, which is objectionable, except for special purposes. The Goulds Manufacturing Co.

The Bordeaux (Fig. 22)is much the same as the above and differs but in minor details. The Deming Co.



[Fig. 23.]

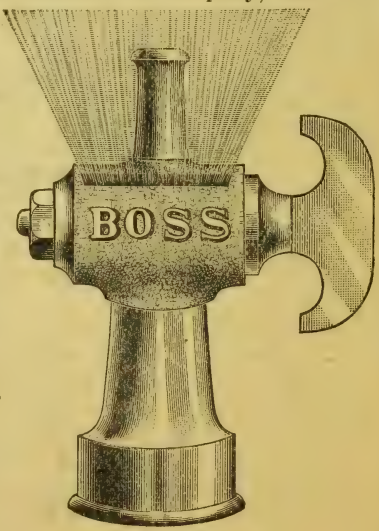
The Instantaneous (Fig. 23) is well adapted for orchard work, throwing large spray over a great distance. With this nozzle the spraying may be done more rapidly than with many of the others. The Lewis Manufacturing Co.

[Fig. 22.]

The Graduating Spray Nozzle (Fig. 24) can be varied from a solid stream to a spray, but the spray is so coarse that the nozzle is not desirable for most purposes. The Goulds Manufacturing Co., and the Field Force Pump Co.

[Fig. 24.]

The Boss (Fig. 25)is a nozzle very similar in the results of its work as the above, although of different construction. Field Force Pump Co.



[Fig. 25.]

The Invincible (Fig. 13) is arranged to throw a fine or a coarse fan shaped spray. It is not easily operated, being too large and heavy. The Gem City Manufacturing Co.

The Lewis Graduating Spray Nozzle (Fig. 11) is another of the nozzles that throws a fan shaped spray. It can be varied in the fineness of the spray and solid stream when operating. The Lewis Manufacturing Co.

Standard Fittings for Spray Machines.

It is often times convenient to use a different nozzle, hose connection, pipe extension, or other part of a spraying outfit with some outfit other than the one to which the particular part to be used belongs. Thus, for example, we may wish to use a Vermorel nozzle upon a Climax pump, but unless the female screw of the Vermorel nozzle has the same thread as the male screw of the hose connection upon the Climax pump, the two cannot be used together without an adapter, to obtain which would put the operator to unnecessary trouble and expense. Upon this account the subject of standard fittings for spraying machines has been agitated, and at a recent meeting of the Association of Agricultural Colleges and Experiment Stations a committee, representing the sections of Entomology, Botany, and Horticulture, was authorized to confer with the manufacturers of spraying machines relative to the adoption of a standard fitting upon all the pumps, so that the present trouble in this regard may be done away with. Also at a meeting of the Association of Economic Entomologists a resolution was passed requesting manufacturers to adopt the standard fittings recommended by this committee.

The committee has published a preliminary report (Circular No. 17 of the Office of Experiment Stations), recommending the adoption of one-fourth inch cloth insertion rubber tubing upon the hand and knapsack pumps, and one-half inch tubing upon the field pumps. With both the one-fourth and one-half inch tubing, an insertion nipple with male screw and standard (fourteen threads to inch) one-half inch thread on distal end, is recommended, and standard one-half inch female screw on the proximal end for the nozzles.

It is hoped that the manufacturers may see the necessity of the adoption of these fittings upon all the pumps, so that we may use any nozzle upon any pump.

The Mechanical Mixture of Kerosene with Water.

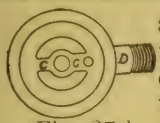
Kerosene makes a most excellent insecticide for the destruction of a great many insects, being quick in its results and al ways at hand. But as kerosene will kill the foliage as well as the insects for which it is applied, it cannot be used as an insecticide in an undiluted state. The kerosene has heretofore been made into an emulsion by mixing with soapsuds or sour

[Fig. 26.]

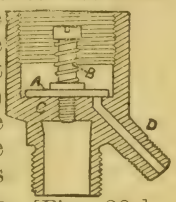
milk and then diluting with water to any extent desired. Different conditions, however, as to temperature, soap, kind of water, and mode of operation, vary the stability of the emulsion, so that while it is very satisfactory in the hands of some, such is not the case in the hands of others. Again, some persons are able to make a satisfactory emulsion at one time but may not be successful at another, although working under what they may consider the same conditions. So that when all things are considered, if the mechanical mixture of kerosene and water will ac-

complish the purpose of an emulsion, it will give much more general satisfaction.

Prof. E. S. Goff of the Wisconsin Station has recently made an attachment to the Climax pump whereby kerosene and water are mechanically mixed. The general nature of this attachment is shown in Fig. 26 and more in detail in Figs. 27 and 28, the former representing a transverse section of the valve and the latter a vertical section. The kerosene attachment joins the main part of the pump just below the valve, so that when the piston is operated both water and kerosene are drawn through the pump and are well mixed when forced through the nozzle.


[Fig. 27.]

While this mixture is not permanent, so far as its use as an insecticide is concerned, this is no objection. We have recently tested this pump with the kerosene attachment upon cabbages, with the result that the cabbage worms (*rapæ*, *protodice* and *brassicæ*) were easily and quickly killed, but the plants were not damaged. The application was made in the proportion of one part of kerosene to fifteen parts of water. By means of a stop-cock upon the kerosene attachment the proportion of kerosene can be varied.


[Fig. 28.]

The kerosene attachment to this pump will be placed upon the market next season by the Nixon Nozzle and Machine Co.

The Peerless Spray Pump (Fig. 13) is also adapted for the mechanical mixture of kerosene and water. The water and kerosene are both placed in the reservoir in the proportions desired and the violent agitation which can be produced with this pump is sufficient to keep the liquids well mixed. With the use of this pump upon the cabbage, radish, turnip, hickory, and apple, damage to the leaves did not result when the kerosene was used in the proportion of one part to fifteen of water. It is probable that this pump may be successfully used in spraying orchards for scale insects, but experiments in this direction have not as yet been made.

The Care of Spray Machines.

A spray pump, like any other machine, will last in proportion to the care taken in its proper use. The mere use of a pump, however, will not injure it so much as a lack of attention in keeping it cleaned and oiled. All working parts should be kept well oiled, any loose screw or nut tightened, and no dirt allowed to interfere with the working of the piston rod. If a pump leaks

at any point, it is an indication that the screw at that point should be tightened or additional packing added. If the nozzle becomes clogged, it should have attention at once, rather than have the spraying done in any half way manner.

When through using a pump for the time being, it should be cleaned by pumping clear water through it. At the end of a season a pump should be taken apart, thoroughly cleaned, oiled, and the packings renewed if needed. With proper care a pump will last many years and prove itself an investment of great value.

What Pump to Select.

The kind of pump to select will depend upon the amount and character of the work to be done. If but one pump is to be purchased, we regard the knapsack as the most satisfactory for all classes of work, but where orchards are to be sprayed and but little attention paid to the small fruits, some of the field pumps, such as the Climax, should be purchased. One pump, however, will rarely answer the many purposes for which one may be needed, and on this account a truck farmer should have one each of the knapsack and field pumps, or, still better, one each of the hand, knapsack, and field pumps. The automatic power pumps, as already stated, are only desirable in spraying upon a very large scale.

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BULLETIN NO. 28.

THE HORN-FLY.

HOWARD EVARTS WEED.

AGRICULTURAL COLLEGE, MISS.

JANUARY, 1894.

The bulletins of the Station are sent free of charge to all farmers in this State who apply for them.

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THE HORN-FLY.

(*Hæmatobia serrata* ROBINEAU-DESVOIDY.)

The Horn-fly is a European cattle pest which first appeared in this country in New Jersey in 1887, and is supposed to have been brought from southern France, where it has been a well known pest since 1830. From New Jersey its spread southward and westward has been very rapid. In 1889 and 1890 it was very abundant in New Jersey, Maryland, and Virginia, and in 1891 had reached Ohio and Kentucky. In the latter year it made its first appearance in eastern Mississippi, being first reported by Mr A. H. Bush of Macon, and at about the same time it was noticed among the cattle at the A. & M. College. By the end of 1892 it became very generally distributed throughout the state, and in 1893 it was so very abundant that it attracted general attention. Being a native of a rather warm climate, it is more apt to thrive in the southern than in the northern states. During the past two years it has not been abundant in New Jersey, where it first appeared; with us, however, it will probably remain a permanent pest, although not as numerous as at present, for in the economy of Nature doubtless its numbers will be lessened through the action of parasites.

The Horn-fly was first studied in this country by Profs. Riley, Howard, and Smith, and it is to the writings of these gentlemen that we owe much of our knowledge of its life history.

DESCRIPTION.

The Horn-fly is shown at *d* in Fig. 1, and is about one-fifth inch in length, and of a dark gray color. It is much smaller than the common house fly and is readily distinguished from the common cattle fly by being slightly smaller, more elongate, and somewhat darker. The large dark-brown compound eyes,

as seen in Fig. 2, occupy a very large part of the head. In the male, shown at *b*, the eyes come closer together than in the female shown at *a*. Surrounding the eyes the head is silvery gray. The antennæ are composed of but two joints, with a feathered bristle attached to the second joint. Upon the lower part of the head is the proboscis which, as shown at *c* in Fig. 2, projects slightly forward. At the sides of the proboscis are two long palpi which are thickly covered with hair. At the upper portion of the head are the three simple eyes, placed in the form of a triangle. The thorax, or that portion just back of the head, is quite large and is crossed in front of the middle by a transverse impressed line, while near the posterior portion of the thorax is a triangular portion known as the scutellum. The abdomen is hairy, small, nearly as broad as long, and slightly flattened above.

An enlarged egg is shown at *a* in Fig. 1. It is small, elongate, somewhat curved, and white, becoming darker before hatching.

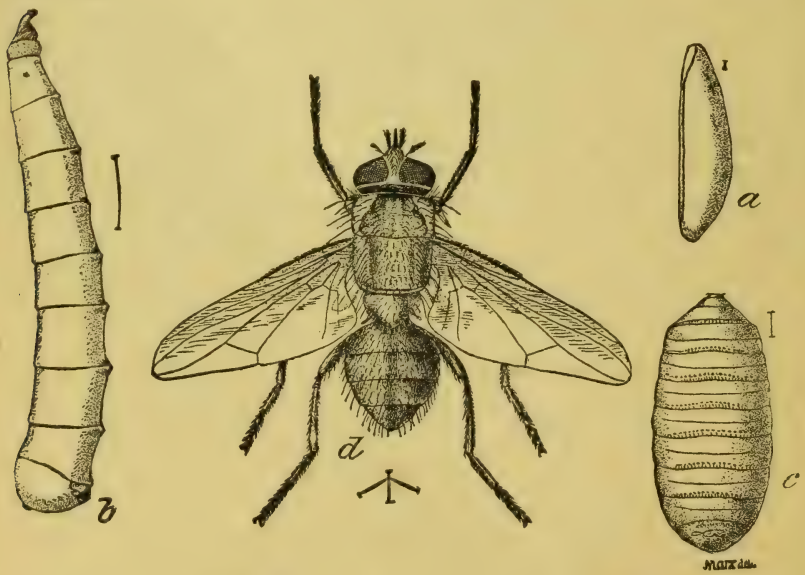

Fig. 1.—The Horn-fly: *a*, egg; *b*, larva; *c*, puparium; *d*, adult in biting position. All enlarged. (From Insect Life.)

The larva is shown at *b* in Fig. 1, and when full grown measures three-eighths of an inch in length. The posterior portion of the body is broadest, tapering slightly toward the head.

The puparium is of a dark brown color, about one-fifth inch in length, and is shown at *c* in Fig. 1.

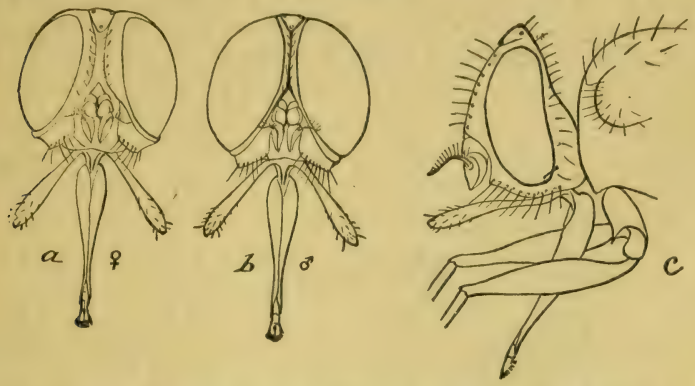

Fig. 2.—The Horn-fly: *a*, head of female, front view; *b*, head of male, front view; *c*, head from side. All enlarged. (From Insect Life.)

LIFE HISTORY AND HABITS.

The eggs of the Horn-fly are laid in fresh cow dung and hatch into larvæ within twenty-four hours. In about eight or ten days the larvæ, having become full grown, form pupæ at or just below the surface of the ground under the manure, and in a few days the flies emerge. The length of time required for the transformation from the egg to the fly will vary somewhat with the weather. During the warmer months it requires but about ten days for the transformation, but on an average it requires about two weeks.

When very numerous the flies are to be seen about the horns, giving them the appearance as shown in Fig. 3, and it is because of their habit of thus alighting upon the horns that has given the species the popular name of "Horn-fly." No damage is done to the horns however, the flies simply resting there for protection from the animal's efforts to avoid them. The flies may also be seen upon the flank and along the back with their

heads generally pointing toward the head of the cow. Another favorite resting place for the flies is upon the forequarters. The eggs are laid singly in fresh cow dung, immediately after it is passed, and after oviposition the flies resume their position upon the cow. In their efforts to avoid the flies, the cattle switch the tail from side to side and jerk the head from one side to the other, causing the flies to leave their position, but they resume it again almost immediately.

Fig. 3.—Horn showing band of resting flies. Reduced. (From Insect Life.)

The flies suck blood from the cattle, producing irritation and worry to such an extent as to cause a decrease in milk from one-third to one-half. It has been our observation that dark colored cattle are more subject to attack from the Horn-fly than are cattle of a lighter color, one often seeing a white and a black cow standing side by side where the former will be nearly exempt from attack by the flies, while the latter will be covered with them. Some writers claim that the thin skinned animals are most attacked, but this has not been our observation, color having more to do with the attack than has anything else, although why this is the case we do not attempt to explain.

Each female fly lays a large number of eggs, and as it requires such a short time for the transformation from the eggs to the flies, there are many broods during the warmer months. They

pass the winter mostly as pupæ, although some flies are to be seen on warm days.

PARASITES.

In the annual report of the Entomologist of the Department of Agriculture for 1890, Dr. Riley mentions eight species of parasitic insects bred from cow dung and it is probable that these insects destroy large numbers of the larvæ of the Horn-fly.

REMEDIES.

The remedies for the Horn-fly consist of (1) various applications to the animals to keep the flies off; (2) applications to the animals to kill the flies; and (3) applications to the dung to kill the larvæ.

During the past two seasons we have experimented with many substances which have been applied to keep the flies from the animals, most of which have proved of but little value, as they evaporate so readily. The following, however, have been fairly satisfactory, as they keep the cattle free from the flies from a week to ten days:

Crude cotton seed oil or fish oil and pine tar mixed, about two parts of the former to one of the latter. The two mix readily and are very easily applied to the animals at milking time by means of a large paint brush. Applied in this manner it takes but a half minute to a cow, making the cost of the application but a small item. We have treated 350 head at a time with the crude cotton seed oil and tar in this way, using but four gallons of the oil and less than two gallons of the pine tar. The cost of the oil is thirty cents per gallon and of the tar about fifty cents, making the total cost of the application to 350 head about $2.20, or about three-fourths of a cent per head.

A preparation known as "Gnat Oil," which is largely used in some localities for Buffalo Gnats, as its name implies, has given about the same success as the above. It is made as follows:

Crude Carbolic Acid, 1 ounce,
Pennyroyal, ½ to 1 ounce,
Sulphur, ¼ pound.
Crude Cotton Seed Oil, 1 gallon.

This was applied to the animals in the same manner as was

the first preparation, and we were unable to see any difference in the animals treated with the gnat oil and those treated with the crude cotton seed oil and pine tar mixture, both preparations keeping the animals free from the flies from a week to ten days, depending to some extent upon how numerous the flies were at the time.

The best application to kill the flies is kerosene emulsion. In 1892 we experimented quite successfully in this line. The milk emulsion was used, made by mixing thoroughly one part of slightly sour milk with two parts of kerosene and then diluting this with twelve to fifteen parts of water. The emulsion was applied to the animals at milking time by means of a knapsack sprayer, directing the spray directly upon the flies as much as possible. After three applications in as many days the flies were killed out so that they were not again numerous until nearly three weeks later. In 1893 the emulsion remedy was again tried but not with as favorable results. The crude cotton seed oil and tar mixture being so cheap and so easily applied, we have adopted this method of treatment as the best.

Some writers have recommended the application of lime or plaster to the cow dung in the field to kill the larvæ as being the best method of lessening the numbers of the Horn-flies. The conditions as to the pasturage of the animals throughout the South, however, is such that this method of treatment is not practicable.

TREATMENT RECOMMENDED.

Application to the animals of substances to keep the flies off is the best treatment for the Horn-fly. Of the many substances used for this purpose, two parts of crude cotton seed oil mixed with one part of pine tar, we consider the best, cheapest, and the most easily applied. It should be applied to the animals at milking time with a large paint brush, the cost being but three-fourths of a cent per cow. If the crude cotton seed oil cannot be readily obtained, fish oil or any other cheap oil may be used in its stead.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 29.

Exhaustion and Restoration of Soil Fertility.

W. L. HUTCHINSON.

Fertilizers and Their Use.

S. M. TRACY.

AGRICULTURAL COLLEGE, MISS.

MAY, 1894.

The bulletins of the Station are sent free of charge to all farmers in Mississippi who apply for them.

SUMMARY.

Nearly every foot of soil in Mississippi was once fertile and productive, and what we have to do to make them all so again is to bring them back as nearly as possible to their original condition. Exhausted soils cannot be made fertile at once by the use of any amount of fertilizer, any more than a poor steer can be made fat immediately by giving him a crib full of corn. It takes time to exhaust a soil, and it also takes time and persistent effort to restore its fertility. Green crops must be the foundation of all restorative work, and then a comparatively small amount of commercial fertilizers will complete the task.

On clay soils which are too poor to produce other crops, sow lespedeza, give a top dressing of meal, and plow the ground at the end of the second season.

When the soil is sufficiently fertile to produce a fair crop, sow cow peas, and fertilize with meal, acid phosphate, or land plaster. Sow the peas early, plow them under early, and sow rye.

On lands underlaid with lime, and in the black prairie region, sow melilotus and plow under at the end of the second season.

For the sandy lands of the pine woods region, cow peas are the best restorative crop which can be grown.

On lands which are already in good condition, and which need only to have their fertility maintained, sow red clover or alfalfa.

The poorer and more exhausted the soil, the greater the need for liberal supplies of humus.

Use chemicals to supply known deficiencies in the soil, rather than as the principal fertilizer.

Save, protect, and use all the stable manure.

Good soils are easily kept in good condition, and should improve with every year of cultivation.

EXHAUSTION AND RESTORATION OF SOIL FERTILITY.

W. L. HUTCHINSON.

EXHAUSTION.

When the producing power of a soil is reduced below a certain point of supposed profitable culture, which may be different for different cases or different crops, it is said to be exhausted, though no one supposes that in any given case the soil is entirely deprived of producing power. The fertility of a soil is dependent upon two things, viz: its natural strength, and its condition. The readiness with which the insoluble plant food in a soil becomes available by natural agencies, and the length of time that this will continue, determine the natural strength, while such physical properties as favor the growth and development of plant roots and the acquisition by these of the available plant food in the soil, determine its condition. The natural strength of a soil may be practically inexhaustible, while a soil in good condition may be easily reduced to one of poor condition. There are few cultivated soils in this state that have not suffered a material loss of plant food, while their once favorable condition is changed to such an extent as to reduce the productiveness of the soil below the point of profitable cultivation. It remains for succeeding farmers to restore the once favorable condition of our soils and, at the same time, obtain from them at least a living.

Exhaustion may be better prevented when the processes by which it is brought about are better understood. A knowledge of the composition of soils and the kind and character of substances which they furnish plants is necessary in our study of the processes of exhaustion. The great bulk of all soils consists of ordinary sand and clay; and the proportion in which these ingredients occur gives rise to the terms sandy, sandy loam, and clayey soils. Besides these, soils contain lime, potash, magnesia, soda, iron, maganese, phosphoric acid, sulphuric acid, chlorine, organic matter containing nitrogen, and water. The sand and the clay are of no importance as plant food; but they have a very great influence on the productiveness of a soil, as in most cases the mechanical condition, and to some extent the temperature, is determined by the proportion of these substances present. The clay also exercises a wide influence by its properties, which enable it to hold moisture and to fix or preserve other substances which are to act as plant food, and thus prevent their leaching from the soil. Plants obtain all of their water, nitrogen, lime,

magnesia, potash, phosphoric acid, and all other mineral food through their roots; and it is all furnished by the soil except in certain cases in which a part of the nitrogen is obtained from the air. Plants cannot take anything from the soil until it is dissolved, or brought in solution. The soil water is the principal dissolving agent, though the plant roots themselves exercise quite an important solvent action. It is thus seen that whenever plants or crops are removed from soils more or less of the plant-food ingredients in the soil have been taken from it, depending on the nature and amount of the crop so removed. This, however, is only one of the ways by which a soil is exhausted. Large amounts of some of the plant-food ingredients of soils are leached out by the underground water and are carried off by the streams. Nitrogen and potash are especially liable to be lost in this way. This source of loss is greatest in the fall and winter months, and is also very much greater from bare lands than from those covered with growing crops. Boussingault, a French experimenter, made some investigations on a soil containing, to the acre, as much as 900 pounds of nitrate of potash to the depth of a foot. After three weeks of rainy weather, during which two inches of rain fell, there was left only forty pounds of the nitrate. It is estimated that the Rhine daily carries into the sea 220 tons of the nitrate; the Seine, 270; and the Nile 1100 tons. All streams and drainage waters contain more or less of these compounds; but in the South both of these sources of loss have been trifling as compared to the loss from surface washing. The greater portion of our surface soil has been allowed to be washed into the valleys or carried by the streams into the seas. In addition to this, some of the organic matter, including the valuable nitrogen, has been converted into gas and escaped into the air. The removal of crops from the soils of the South has been a rather small factor in their exhaustion and in many cases we can hardly regard the soils as having been exhausted at all. They have been washed away. As all loss of plant-food ingredients from the soil by surface washing can be prevented, and should be reduced to a minimum. Without this, any effort to restore fertility to the soil will meet with poor success. The losses which are sustained through the leaching of underground water may be largely prevented, though not entirely. This loss is best prevented by keeping the ground always covered by a growing crop, especially during the fall and winter, when this loss is likely to be the greatest. Organic matter and clay have a tendency to fix the plant-food ingredients and prevent their being carried out by the water and this is the reason that land with a clay subsoil is so well adapted to improvement. It is also true that by incorporating organic matter into it, a

sand bed may be made to retain plant food quite satisfactorily. The character and amounts of plant-food ingredients contained in different crops is shown in the following table compiled by Mr. Patterson, of the Station staff:

AMOUNT AND VALUATION OF FERTILIZING INGREDIENTS CONTAINED IN COMMON SOUTHERN AGRICULTURAL PRODUCTS.

PLANTS.	Bushels per acre	Pounds per acre	Pounds Nitrogen per acre	Pounds Potash per acre	Lbs. Phos. Acid per acre.	Value
						$
WHEAT—grain	25	1500	30.75	8.40	13.50	5.71
straw		3500	19.00	38.50	7.00	5.12
chaff		250	1.80	2.10	1.00	.42
whole plant		5250	51.55	49 00	21 50	11.25
OATS—grain	35	1225	21.56	5 88	2.45	3.65
straw		3000	16.80	48.90	8.40	5.39
chaff		250	1.60	1.12	.32	.31
whole plant		4475	39.96	55.90	11.17	9.35
CORN—grain	50	2800	46 80	10 36	15.96	8.34
fodder		1200	20.28	46.80	5.88	5.69
cobs		470	1 08	1.08	.09	.22
husk		420	2 89	6.51	.34	.77
whole plant removed		4890	71.05	64.75	22.27	15.01
RYE—grain	25	1400	24 64	8.12	11.90	4 69
straw		3500	14.00	30.10	8.75	4.04
chaff		310	1.79	1.61	1.73	.44
whole plant		5210	40.43	39.83	22.38	9.17
BARLEY—grain	25	1200	19.20	5 64	9.36	3.63
straw		2500	10.00	21.50	6.25	2 89
chaff		180	.90	2 07	.52	.26
whole plant		3880	30.10	29 21	16.13	6 78
COTTON—seed cotton		1000	27.77	10.96	9.50	5.19
lint cotton		333	.83	2 63	.20	.27
*COW PEAS—vines (hay)		6000	97 80	54.78	31.62	18.99
peas	25	1500	53 30	21.60	13.35	9.75
hulls		500	5 00	2.30	80	.91
SWEET POTATOES	200	12000	27.60	56.40	19 20	7.92
IRISH POTATOES	100	6000	12.00	17.40	4 20	2.89
TOBACCO		500	17.50	53.48	7.00	5.64
BERMUDA HAY		4000	37.20	76.40	15 26	10.16
*LESPEDEZA HAY		4000	82.80	21 60	17.60	14 38
*MELILOTUS HAY		6000	118.00	109.80	33.48	24.87
*RED CLOVER HAY		4000	87.20	91.20	17.88	18.49

*Restorative crops.

In explanation of the table it should be stated that crops which derive all their nitrogen from the soil are known as "exhaustive crops," while those which have the power to assimilate their nitrogen from the air are commonly known as "restorative crops." To the latter class belong cow peas, lespedeza, melilotus, red clover, and other leguminous plants, which are among the most valuable restorative crops known, even though they may be cut for hay, and the bulk of the crop removed from the land.

RESTORATION.

The first effort that should be made in an attempt to restore fertility to a soil is to stop, as far as possible, any further loss of plant food ingredients except such as are removed in crops. Some of the ways of doing this have been alluded to under the previous heading. There are various ways known to every farmer for preventing surface washing, any or all of which may be resorted to as circumstances may demand. Levying, tile drainage, deep culture, subsoiling, and sodding are among the most important means to be used for this purpose. Loss from leaching is most satisfactorily prevented by keeping the land always covered with growing crops to take up the plant food as rapidly as it becomes soluble, while a clay sub-soil and a liberal amount of organic matter have a tendency to prevent losses by leaching. Deep culture and all other operations that give land a large absorbing power for water are beneficial. Having adopted such precautions as will prevent surface washing and loss from leaching, or at least reduce them to a minimum, it becomes a comparatively easy matter to repay the losses sustained by the removal of crops, and to increase the amount of available plant-food ingredients in the soil.

Two means may be resorted to for this purpose, viz: the application of manures and fertilizers, and the aiding of the processes of Nature in bringing into a soluble condition some of the insoluble ingredients of the soil. Gypsum, or landplaster, and lime are the two substances which are almost exclusively used for the latter purpose, and they are sometimes called stimulant fertilizers. Gypsum releases potash, and the functions of lime are thus given by Dr. Hilgard:

"a. It improves the mechanical condition of the soil.

b. It renders the phosphoric acid and the potash in the soil more readily available.

c. It favors nitrification.

d. It preserves the humus."

It is often found advantageous to still further aid the accu-

mulation of available food by turning green crops into the soil. In returning to the soil, by the use of chemical fertilizers, such ingredients as are removed by crops it has not been found profitable to return any except nitrogen, phosphoric acid, and potash. In many instances it is only necessary to return one; and in others, two of these three substances. In practice, it has been found best to apply phosphoric acid in the form that is soluble in water. Complete commercial fertilizers aim to supply these three substances; and generally contain, to the ton, from 150 to 200 pounds of phosphoric acid and from 25 to 40 pounds each of nitrogen and potash. Where 500 pounds of such a fertilizer is put on an acre there is returned to the soil from 35 to 50 pounds of phosphoric acid and from 6 to 10 pounds each of nitrogen and potash. On the lime soils of this state, such as are found in the north-east and central prairie regions, the application of fertilizers has failed to produce an increase of crop. The failure of these soils to produce large crops seems to be due entirely to their unfavorable mechanical condition, which may be readily corrected by growing on them such tap-rooted plants as red clover, cow peas, and melilotus. On the yellow loam lands of the state, a return of phosphoric acid seems to do but little good; while an application of potash and nitrogen gives good results. On the sandy and sandy-loam lands, a complete fertilizer should be used in such quantity as to return to each acre at least 40 pounds of water-soluble phosphoric acid, and 10 pounds each of nitrogen and potash. Larger applications will be found to give good returns.

NITRIFICATION AND ROTATION OF CROPS.

It is by nitrification that the nitrogen in the soil is converted into nitrates and ammonia salts, the principal forms in which nitrogen is available for plant food. The conditions favorable for the nitrification of the organic matter in the soil are as follows:

1. Porosity, which allows a free circulation of air through the soil, and thus oxygen, one of the necessary agents, is furnished.

2. A moderate amount of moisture. Excess of water or absolute dryness stops the action.

3. Proper temperature, the most desirable being 98 deg. F., the extremes being 40 and 130 degs. F.

A rich sandy-loam soil usually furnishes these conditions in summer in a very satisfactory manner, and by proper tillage and management all soils may be brought to a condition favorable to nitrification, and to do this should largely be the object of all field operations.

Rotation of crops may often be used to advantage in maintaining the fertility of a soil or in restoring fertility to it. Crops appear to feed almost as differently as animals do, though this difference must be understood to mean the portions of the soil from which crops obtain their food, the proportion of the ingredients taken up, and the relative ease with which they obtain food from the soil. Some crops appear to be coarse feeders, and obtain bountiful supplies of food where others can get but little; and again, some get their food from deep in the soil, while others feed near the surface; some take up larger proportions of potash, while others give preference to nitrogen or phosphoric acid. Again, some plants leave large quantities of organic matter, containing nitrogen and mineral ingredients in the stubble and roots which are left in the soil; while others leave very little. Some are allowed to produce seed; others are not. Some make their principal growth in winter; others, in summer. All these facts influence the effects of different crops on soil. Red clover leaves in the soil three to four times as much vegetable matter, in the stubble and roots, as do rye, barley, oats, or wheat; and in the clover plant there is half as much root as top, while in the cereals there is only about one-fourteenth as much. Cow peas and melilotus belong to the same family as red clover; and, like it, obtain a large amount of their food from the lower layers of the soil. All of these plants have the power of collecting, through their roots, atmospheric nitrogen, and this adds to their fitness to act as restorative crops. They collect and concentrate in the upper layers of the soil large quantities of available plant food; and by means of their long tap roots, render the sub-soil open and porous, facilitating drainage during excessive rain, and aiding in the elevation of water from the lower to the upper layers of the soil during excessively dry weather.

FERTILIZERS AND THEIR USE.

S. M. TRACY.

During the six years since this station was organized it has given more attention to the use of fertilizers, the kinds best for use on different soils, and the best methods for using them, than to any other subject. In this work the station has used fields representing the four soils most common in the state; the sandy clay region of the north-west, the black prairie of the north-east, the yellow clay loam of the central region, and the sandy pine woods soil of the southern part of the state. Hundreds of plots have been used, some of them continuously with various forms of commercial fertilizers, others have been fertilized only by the turning under of green crops, while on still others the two methods have been combined. Partial reports of the results of this work have been published in the Annual Reports of the station and in Bulletins 5 and 24, while the present bulletin gives the results secured up to the close of 1893.

The use of fertilizers is one of the most complex questions with which the farmer has to deal, as their effects are always greatly modified by the condition of the soil to which they are applied, the previous cropping of the land, and the character of the season during which they are used. Cotton seeds are always beneficial to heavy clay soils, while they are almost worthless for very light and sandy soils; kainit is of no benefit on newly cleared hardwood timber lands, while it is of the highest value on those same lands after they have been in cultivation so long that the supply of available potash is exhausted.

Fertilizers act both chemically and mechanically, the latter action being, in many cases, of even greater importance than the former. A very stiff clay soil may contain an abundance of plant food for a heavy crop, and at the same time be so hard and compact as to be almost sterile. If such a soil be made light and porous by any means, even by mixing with it sand, gravel, broken brick or any other similar material, its producing power will be greatly increased; while if it be made loose by an application of cotton seed, coarse stable manure, or even straw, it will be still more improved. On very light and sandy soils however, the seed and coarse manure might be positively injurious by making a too light soil still lighter; and for such lands meal, well rotted manure, or commercial fertilizers will be much more beneficial. The mechanical condition of a soil has fully as much to do with its productiveness as has its chemical qualities, and in fertilizing any land the most important thing to be done is to

first bring it into a good mechanical condition, after which its natural fertility will go far toward supplying the needs of the growing crop.

To be in good mechanical condition the land must be well drained, either naturally or artificially, it must have a subsoil which is sufficiently porous to allow the roots to penetrate deep, and it must be free from hard lumps and clods. Good drainage is, perhaps, the most important, as when that is secured, the other conditions are easily obtained. Land which is rolling, or that which has a moderately sandy subsoil, seldom needs artificial drainage, but on almost every farm there are wet and seepy hillsides or low and wet places along creek bottoms which can be greatly improved by a few open ditches to cut off seepage from above, or can be brought into a still better condition by laying a few lines of tile. Tile is now manufactured at West Point, in this state, and though it is more expensive at first, it gives the best results and leaves the fields free from the open ditches which make cultivation inconvenient and which require constant care.

If the subsoil is too compact, as in a great part of the black prairie region, it can be loosened most easily by the growing of plants having strong tap roots, like those of melilotus, red clover and cow peas.

It is commonly said that a "complete" fertilizer need contain only the three mineral elements which are usually deficient in the soil, viz: potash, phosphoric acid, and nitrogen. Practically however, we find that though a soil may be rich in each of the elements which go to make up the plant, it is impossible to secure good, or even fair crops, unless it contains, in addition to these, a liberal supply of humus, which is formed whenever vegetable matter decays in the soil, and it is in the formation of this material that the practice of plowing under green crops has its greatest value. It is plentiful in all fresh soils, but becomes exhausted by continued cultivation in hoed crops, especially in the hill lands, and the supply must be renewed before chemical fertilizers can be used to advantage. It is the necessary foundation of all fertility, and without it the use of any commercial fertilizer is sure to be disappointing. If the fertilizers used do not contain humus-making material it must, sooner or later, be supplied by the plowing under of green crops, or by turning the land out to rest.

A chemical analysis of almost any soil will reveal the presence of a sufficient amount of potash, nitrogen, and phosphoric acid to produce good crops for many years to come, but unfortunately, such analyses show nothing of their condition or availability for immediate use, and so are of but little value in deter-

mining the amounts or kinds of fertilizers needed for different fields. The ordinary soils of Mississippi contain over 2,000 pounds of phosphoric acid (equal to about 10,000 pounds of acid phosphate) per acre, and if this were all available it would be largely in excess of the needs of any crops. As a matter of practice we find that, on many soils, when we add 250 pounds of acid phosphate, or two and one half per cent of the amount already in the soil, the yield will be nearly or quite doubled.

While it is a simple matter to make an analysis of a soil, and of the crop which we may wish to grow upon it, these analyses tell us little as to what may be the best fertilizer for us to use. The chemical analysis of a soil does not tell us its condition, whether the plant food it contains is in an available form, or anything of its mechanical condition. Plant food in the soil may be available for one kind of plant while it is not so for another, and, for some reason which we are unable to explain, all plants grow best in a soil containing certain available elements far in excess of the amounts consumed in growth. It is known that an abundance of nitrogen is necessary to produce a vigorous growth, that potash is necessary for the production of the woody parts of the plant, and that phosphoric acid is consumed largely in the production of the seeds; but in order to produce the best results these elements should be furnished to the soil in different proportions for different plants, and these proportions are by no means those found in the plants themselves.

The whole question of fertilizing thus resolves itself into a consideration of whether we can best modify the soil so as to make the food which is already present available, or whether it will be cheaper to add fresh supplies. In nearly all cases we find a combination of the two methods more economical than is the close following of either. Much of the unavailable food in the soil can be made available by draining and thorough cultivation and pulverization of the soil, the plowing under of an occasional green crop will maintain the supply of humus, and with such treatment the addition of comparatively small amounts of commercial or other fertilizers will be all that is needed. Whether it will be most economical to produce all the fertilizers needed on the farm, or to purchase the more concentrated commercial forms, must depend largely on the circumstances of the farm where they are to be used, and is a matter which will be considered in later pages of this bulletin.

A fertilizer is any substance used for increasing the available plant food in the soil.

Fertilizers may be classed as (1) Natural, and (2) Chemical. Natural fertilizers include stable manure, composts, cotton seed in its various forms, green crops, and marls.

STABLE MANURE.

Stable manure is undoubtedly the best fertilizer we have for general use, as it contains all the elements needed for plant growth in a condition in which they soon become available; and in addition, its principal bulk is composed of humus-making material which is needed for all excepting very fresh or alluvial soils.

Although stable manure is regarded as a "complete" fertilizer, and is a standard with which others are compared, it is of very variable composition, its value being determined by the animals from which it comes, their food, age, and condition, the amount of straw and bedding which has been mixed with the droppings, whether it has been sheltered or exposed to leaching rains, the length of time since it was made, and by many other causes. An increase in the amount of cotton seed meal fed to the animals is very quickly followed by a corresponding increase in the amount of nitrogen in the manure, wheat bran gives a marked increase in the phosphoric acid, while there are few feeds which give a manure richer in potash than does clover hay. In some recent experiments made at the New York (Cornell) Station the value of the manure from cows fed on different rations varied from $1.76 to $2.47 per ton, and from $1.69 with calves to $4.17 with sheep These figures give the results of work done where the ration was rich in grain, and where nearly all the urine was saved by using water-tight floors or a sufficient amount of bedding. Had the urine been allowed to waste the value of the manure would have been much less, as large proportions of both potash and nitrogen are excreted in the urine.

The fertilizing values of some of the more common feeding stuffs, as given in the "Experiment Station Hand-book" per ton are as follows:

	Potash.	Phosphoric Acid.	Nitrogen.	Total.
Mixed Hay,	$1.05	$ .27	$4.23	$5.55
Red Clover,	2.20	.38	6.21	8 79
Alfalfa,	1.68	.51	6.57	8.76
Melilotus,	1.83	.56	5.94	8.33
Cow Pea,	1.47	.52	5.70	7.69
Corn Silage,	.37	.11	.84	1.32
Oat Straw,	1.24	.20	1.86	3.30
Oats,	.62	.82	6.18	7.62
Corn Meal,	.80	.63	4.74	6.17
Corn and Cob Meal,	.47	.57	4.23	5.27
Wheat Bran,	1.61	2 39	8.01	12.01
Rice Bran,	.24	.29	2.13	2.66
Cotton Seed Meal,	1.79	2.68	19.92	24.39

It should be borne in mind that the figures given above represent the nominal fertilizing values of the different feeds, and are far from showing their actual values when used in the field. Under good barn management not more than eighty per cent of the fertilizing value of food given to stock is recovered in the manure, and when the urine is allowed to waste not more than fifty or sixty per cent is recovered. There is a still further loss from the fact that fields seldom need the different fertilizing elements in the exact proportions in which they are found in the manure, and so a portion of such as are in excess of the amounts needed will not be consumed. To balance this loss however, there is a positive gain in the humus-making material which has not been counted in the estimated value, and for clay soils which have been in cultivation for a long time the humus is often of greater value than the combined potash, phosphoric acid, and nitrogen. The actual value of stable manure will vary with every variation of the field to which it is applied.

As the most valuable parts of the manure are the urine and the soluble portions, it is very poor economy to take it out of the stable and expose it to the weather in the yard. In order to retain its original value it must be preserved from both leaching and heating, and this may be accomplished in several ways. Where neat cattle alone are fed it is a very common practice to allow the manure to accumulate in the stalls during the whole feeding season. This is an excellent plan when sufficient bedding is given to absorb the urine and keep the stalls dry. All the excrement is saved, and when kept tramped down in such a compact mass there will be no heating. Horse manure cannot be kept long in this way, as it heats more readily. A cheap and convenient shelter for manure may be made by digging a pit two feet deep, throwing the dirt to the sides so as to make them higher than the level of the yard, and sloping the ends so that a wagon can be driven through. Make the pit twenty-five feet wide, and long enough to hold the accumulations of six months, covering it with a roof extending two feet beyond the sides, and high enough so that a wagon can be driven through. Run a single line of plank from the stable door to this pit, and the manure can be wheeled out daily and thrown in with very little trouble. In this way most of the urine can be saved, and if the bottom of the pit is of well tramped clay there will be almost no loss from leakage. Should the pit contain a large proportion of horse manure, heating may be prevented by arranging a gutter to carry water from the roof, and give the pile an occasional wetting down. A pit similar to the one described, and twenty five by forty feet, has been in use here for several years, and holds all the accumulations from about eighty cattle and fourteen mules

during four months, and has never given trouble by heating. There will always be more or less manure scattered about the yard and this, together with the refuse feed, mouldy hay or grain, blood and entrails from butchering, and other waste material should always be thrown into the pit with the manure. If hogs are kept where they can have access to the pit, they will secure a considerable amount of food from it, especially when the cattle are fed with whole corn, and will add largely to its value by their own droppings, and by keeping it so thoroughly stirred as to prevent heating.

While the two methods of keeping manure which have been described are the best economy, there are many farms on which it is not convenient to practice either, and the manure must be left exposed to the weather from the time when it is taken out of the stable. In such cases it is usually best to haul and spread it on the field at once, and then plow it under when convenient. When spread on the field there will be no loss from heating, and nearly all of the soluble matter which is washed out by the rains will find its way into the soil and be retained near the surface. Clay absorbs impurities from water much more thoroughly than does sand, so that if the manure is to lie in the field for some time before plowing under, it should be put on those fields having a clayey rather than a sandy soil. Heavy clay soils are greatly improved in their mechanical condition by the use of coarse and fresh manures, while for sandy soils which are already too light it is better to use the older and more decayed manures. The custom of hauling manure to the field and piling it in heaps is seldom good economy, as if the heaps are large, they are almost sure to lose by heating, and in any case, the manure has to be handled the second time. The principal cause of loss, both in value and amount, are from the washing and leaching to which manure is exposed in an open yard, and any plan which will prevent these, or which will transfer the leaching process from the stable lot to the field, will save fully one-half the value of the manure from an open lot which is cleaned up but once a year.

COMPOSTS.

In the northern states, where the seasons are short and the period of active plant growth extends over only a few weeks, great stress is laid on the importance of composting manures and having them thoroughly rotted before using. Fresh stable manure contains a very large percentage of water, and a smaller percentage of soluble plant food than it does when composted and thoroughly rotted, but in composting nothing is added to the material already in the manure. By composting, it becomes

more thoroughly mixed, and decay is hastened so that a larger proportion of it can be used at once by the plant, but it is also rendered less lasting in its effects. Here, where the growing season is longer than at the north, the rainfall greater, and decay more rapid, composting is of much less advantage, and for ordinary farm crops for which stable manure alone is used, it will seldom pay for the necessary labor. When the manure is wanted as a top-dressing and for immediate effect, or where the supply is limited and is to be increased by the use of commercial fertilizers, it will often pay well to compost in order to secure a thorough mixing and more even distribution in the field.

COTTON SEED.

When a sufficient supply of stable manure is not available, cotton seed, in some form, is an excellent substitute, and is probably the best material which can be used on soils which need either nitrogen or vegetable matter. Five years ago, when the seed could be purchased for six dollars per ton they were, in nearly all cases, the most effective fertilizer which could be bought for the money, but with the increased demand for them, and the higher price for which they are now sold, it will often be found cheaper to supply the needed vegetable matter by the plowing under of green crops, and to supplement that by the use of commercial fertilizers. Whether whole seed, meal, or hulls, can be used to best advantage depends on the condition of the soil and crop to which they are applied. On heavy clay soils seed will be much more beneficial than meal, both on account of its greater bulk of humus-making material, and also its greater mechanical effect in making the soil lighter.

The form in which the seed is used will influence the rapidity of its action. It must decay and become soluble before it can be used by the growing crop. If fresh seed is used, this will require some weeks; if the seed is killed by wetting and heating, or by steaming, the processs of decay is hastened; and if the seed is crushed, it will be ready to act still more quickly.

When a stimulating fertilizer is wanted to push a crop forward rapidly for a short time only, the meal is better than even crushed seed, as it decomposes so rapidly as to become available in a few days, and will produce its whole effect within a few weeks. On very light and sandy soils which are already loose and friable, and where the soil is underlaid with gravel so as to leach badly, meal is more economical than seed, and when the fertilizer is to be applied to growing crops, meal is always to be preferred. Cotton seed hulls have but little fertilizing value. Where the main object is to loosen a too heavy soil, or a mulch

is wanted to protect tender plants, strawberries, etc., they are useful, but under ordinary circumstances are worth more to use as food for stock than as a fertilizer for field crops.

GREEN MANURING.

Green manuring, or the plowing under of green crops, is the cheapest and most effective method for building up poor soils, and for maintaining the fertility of those already in good condition. It furnishes the necessary humus, it leaves supplies of potash and phosphoric acid in the surface soil where they are immediately available for future crops, and when leguminous crops are used, large amounts of nitrogen are assimilated from the air and made ready for other crops to use. On heavy soils its mechanical effects are very marked, not only in loosening the surface soil which is turned by the plow, but also by loosening the subsoil deeply and so making it permeable to the roots of other crops. Green manuring is to fertilizing what grazing is to raising cattle. Crops can be grown by the use of stable manure, cotton seed, and chemicals, and cattle can be grown on a diet of dry hay and grain, but neither is the most economical plan to be pursued permanently. In Mississippi we are fortunate in having a large number of plants which can be used for this purpose, some of which are perennials like alfalfa and red clover, others like melilotus are biennials and do their work in two seasons, while still others, like lespedeza and cow peas, are annuals. Vetches and rye can be grown during the winter months, and a crop of pea vines can be grown in two months of summer weather. There is no time in the year when it is not possible to have restorative crops growing which will go far toward preparing the ground for succeeding crops. The plants most commonly used for green manuring are the legumes, the best of which are cow peas, melilotus, alfalfa, red clover, and lespedeza; and also the grasses. Of these, the leguminous plants are far more valuable than are grains and grasses, from the fact that they have much larger and stronger root systems, and so are able to gather food which is beyond the reach of the more shallow rooting grasses. They are all plants having strong tap roots which will force their way through the subsoil and so make it loose and porous; they bring up from the subsoil a large amount of potash and phosphoric acid which is left in the surface soil, and as nearly all legumes are rank growers they furnish more humus-making material than do the grasses. The most important reason, however, for using the legumes is the fact that they are able to assimilate nearly or quite all their nitrogen from the atmosphere, while most other plants consume only that which is already in the soil. Ni-

trogen is the most expensive element of plant food, and the one which it is the most difficult to secure. The roots and stems of of grasses contain only about one and one-half per cent of nitrogen, while the amount found in legumes is about two and a half per cent. While the grasses take one and a half pounds of nitrogen from the soil, elaborate it into plant food, and then leave it in an available condition for future crops, the legumes take nearly double the amount from the air where it is unavailable for other plants, and add it to the amount already in the soil. The roots and stems of legumes are also richer in both potash and phosphoric acid than are the grasses, and so, both chemically and mechanically, they are the more valuable plants for use as green manures.

Cow peas are very commonly used for green manures from the fact that they will grow on almost any soil, will make a large bulk of stems and roots, and can be grown in one season. When a restorative crop is wanted to occupy the ground for one summer only this is the best which can be grown, and if planted early, the crop will mature in time for a second crop to be grown on the same land if desired. Whether the vines should be cut for hay and only the roots and stubble used for manure, and whether the vines should be plowed under in the fall or left to protect the surface from washing during the winter, are the questions which bring out long discussions at almost every farmer's institute, and which no single statement will answer. Various plans have been followed at the Station, and we find that in this, as in all other work with fertilizers, we must be governed by the condition of the field in which the crop is grown. On heavy soils we have found it much better to plow under the whole crop, while on lighter and more sandy soils we have found it better economy to graze the crop, as such soil needs compacting rather than loosening, and the droppings from the cattle compensate for a large part of the fertilizing material carried off. If soils are liable to wash, it is desirable to have them covered during the winter, and in such fields it is better to defer plowing until spring than to leave the ground bare three or four months. If the peas are planted so as to mature in August and are then plowed under, the ground will soon be covered with a second growth of vines, wild grasses and weeds, which will give fair winter protection. When pea vines are allowed to remain on the surface of the ground during the winter they lose very largely, both in humus-making matter and in nitrogen, and so are far more effective as a fertilizer when plowed under in the fall. Cow peas respond very quickly to an application of fertilizer, meal, acid phosphate, and land plaster being the best for such use, and in many cases we have found that it paid better to secure a rank growth by using fertilizers on the peas than to have

the smaller crop of vines and to use the fertilizer on the succeeding crop. When grown on very stiff soil where all the vines were to be plowed under for their loosening effect on the land, we have found it an economical plan to plow as soon as the vines were mature, and then to sow rye, oats, or barley for a winter growth. In this way the full effects of the vines are secured to the soil, while the grain crop covers and protects the soil from washing during the winter. Of the three crops named, rye is the most hardy and the one to be preferred. It is only when such a crop is wanted for winter growth that any of the grains or grasses can be recommended for green manuring, as they are all shallow rooting plants which add nothing to the soil except humus-making matter, and their principal value is in their power to grow during the winter, and so hold in the soil the fertility which has been accumulated and made available by the leguminous crops.

For lime soils in which the supply of humus has been exhausted by long cultivation, and which are too poor and hard to produce a good growth of peas, lespedeza is the best crop which can be grown, as it will make a fair growth on the hardest and thinnest of soils, and even there it will send its tap roots a foot or more into the ground and do good work in preparing the land for peas or other more rank growing plants. A top dressing of meal applied in June is a wonderful stimulant to lespedeza, and where the field is to be cultivated the next season, will make a good profit on its use. Lespedeza will make a moderate growth on the poorest clay hills, and will improve with each succeeding crop so that, in time, the most exhausted fields may be made productive by its use, though the work may be greatly hastened by plowing the land after one or two years. As it does not mature until late in the fall it is better not to plow the land until spring, when if plowed early, the lespedeza will again cover it without reseeding, and will make a much better growth than on land which has not been plowed.

Red clover is undoubtedly the best plant which can be grown for green manuring on soils where it will succeed, and when a crop is wanted to occupy the ground for two years or more. It requires a fairly good soil for its growth, and its bulk of root is not equal to that of melilotus, but its hay is of such superior quality that, on the whole, it is the best plant to use for maintaining fertility on soils which are already good. As a green crop to be grown as a part of a rotation it has no equal, but it is not advisable to plant it on very thin soils, or on soils which are poorly drained or very sandy. It is a plant for maintaining fertility rather than for the building up of exhausted soils. It succeeds admirably on the black prairie soils, and its culture can be made very profitable in all that section of the state.

For strong lime lands, even those which have become greatly exhausted and are in bad mechanical condition, melilotus is the best restorative crop which can be grown. It will grow on the white limestone points which will support no other plants, and will make heavy crops on the black prairie lands where the subsoil has become so compact that it cannot be penetrated by the roots of cotton and other plants. Its large roots give it a remarkable power in rendering this subsoil porous, and by their decay at the end of the second season they leave the ground full of small openings which assist greatly in draining and aerating the soil. It requires much less care in planting than does red clover, will grow on a poorer soil, will make a larger bulk of both stems and roots, and if cut when not more than two feet high, will make excellent hay.

Although alfalfa grows well in many parts of the state, and is one of the best hay plants on loose and well drained soil, it is not often grown where green manuring is the main object of the crop. Pound for pound, its roots and stems are worth about the same as those of red clover, but it is more difficult to secure a good stand of the plants, and as when the stand is once secured it will remain good for many years, it is more valuable as a hay-producing plant than as a fertilizer.

To sum up the whole matter: we find lespedeza the best restorative crop for very thin and barren soils. When the soil has been partially restored by the use of lespedeza, improvement can be hastened by using cow peas; and on land which is to be used for a green crop during one season only, peas are best. On all lime soils which are in poor condition, melilotus gives the best results; and for soils which are already fertile and in good condition, needing only to be kept up and gradually improved, red clover is the best green manuring plant we have.

MARLS.

Marls are found quite commonly in the northern part of the state, and occasionally in the central and southwestern sections, but are seldom rich enough to make them of sufficient value to pay for hauling long distances. The best specimens we have received have been from Wayne and Newton counties, and which had a nominal value of about two dollars per ton. None of the Mississippi marls, so far as known, contain over 2.06 per cent of phosphoric acid, which was found in a sample from Lowndes county; and a sample from Wayne county contained 2.27 per cent of potash. If the beds are near at hand, it will be profitable to haul such marls for use on creek bottoms and "sour" soils, but there are few cases in which it will pay for hauling more than

two or three miles. From ten to twenty loads per acre should be used, and it will be more effective if applied to the land just before plowing under some green crop. In estimating the values of our marls, no account has been taken of the lime which they contain, as nearly all lands in the immediate vicinity of marl deposits are already well supplied with that material.

COMMERCIAL FERTILIZERS.

The economical use of commercial fertilizers is one of the most difficult problems with which we have to deal, as in many cases they are the cheapest and best fertilizer which can be obtained, while in other cases the money paid for them might as well be thrown away. The so-called "complete" fertilizers, which are so commonly used, are composed largely of acid phosphate, which supplies the necessary phosphoric acid. The potash is supplied in the form of kainit, muriate of potash, or sometimes hull ashes; and the nitrogen is added in nitrate of soda, sulphate of ammonia, cotton seed meal, castor pomace, dried blood, and other similar materials. The composition and values of the different brands sold in this state are so fully treated in Bulletin No. 2, published by the State Chemist, that the matter need not be repeated here. Copies of this Bulletin may be had by addressing Prof. W. L. Hutchinson, State Chemist, Agricultural College, Miss.

In many cases these "complete" fertilizers are the best and most economical which can be used, but as most soils already contain a sufficient supply of one or two of the fertilizing elements, it is usually better to purchase the raw materials, and mix them in the proportions in which they may be needed. It is needless to apply nitrogen to fields in which pea vines or clover have recently been plowed under, or potash to recently cleared timber lands. Whether it will be best to purchase potash, phosphoric acid, or nitrogen, will depend on the natural character and present condition of the field where it is to be used.

On soils which have been in cultivation some time, potash has always given good results, and the best forms in which it can now be purchased are as kainit, muriate of potash, and hull ashes. The Station has used each of these continuously, and for all ordinary crops there seems to be but little difference in the value of the same amount of potash from either. Kainit usually contains about twelve per cent of potash, muriate about fifty, and hull ashes about twenty With these proportions, four hundred pounds of kainit contains the same amount of potash as is found in ninety-six pounds of muriate, or in two hundred and forty pounds of hull ashes. In other words, if the kainit is worth

fifteen dollars per ton, then the muriate will be worth sixty-two and one-half dollars, and the hull ashes twenty-five dollars. Which should be purchased will depend on the local selling price of each. It should be noted, however, that hull ashes, in addition to the twenty per cent of potash, contain about nine per cent of phosphoric acid, which gives them an additional value of about five dollars per ton for use where phosphoric acid is needed. At the prices for which these materials have been sold for the last three years, hull ashes has been the cheapest form in which potash could be purchased, but at present the prices of both hull ashes and kainit are increasing, while muriate of potash is sold for much less than was its price a few years ago.

Where phosphoric acid is needed, as it is in considerable quantities on all soils not rich in lime, and to a less degree on lime soils, acid phosphate is undoubtedly the cheapest and best form in which it can be obtained. The fertilizer values of the different brands of acid phosphate vary with the amount of water and citrate soluble phosphoric acid which they contain, those having the larger proportions of these being the more prompt in their action, and more expensive to purchase. We have found it more profitable to use the more soluble forms on early maturing crops like grain and corn, while for cotton, which continues to grow until killed by frost, the less soluble and less expensive grades have given good results.

When both hull ashes and phosphoric acid are to be used on the same field, they should never be applied at the same time as, if mixed while fresh, the ashes render the phosphoric acid insoluble and unavailable for immediate use by the plant, though kainit and acid phosphate may be mixed without injury to the latter. Potash fertilizers being more easily soluble than the phosphates, we have found it better to apply the phosphates from one to two weeks before using the potash. When large amounts of fertilizers have been used we have found it more profitable to apply them broadcast before planting, but where the application is small, three hundred pounds or less per acre, we have found it better to put it in the drill and mix thoroughly with the soil by running a "bull tongue" plow along the rows before planting. When using both phosphate and potash fertilizers we have found it better to apply the phosphate before planting and the potash at the first cultivation.

When a soil is rich in humus it is seldom necessary to make any further application of nitrogenous fertilizers, and as they are very quickly soluble, and are soon lost to the soil by both leaching and volatilizing, they should never be used until the crop has made a considerable growth. Cotton seed

meal and nitrate of soda are the best forms in which nitrogen can be purchased, and for general use the meal is preferable. As nitrogenous fertilizers have a much greater effect upon the growth of the plant than upon the production of fruit, they are not needed on soils which will produce a satisfactory growth of stalk, but may be used to great advantage where the plant growth is weak and small.

Very few commercial fertilizers contain any appreciable amount of humus-making material which is so essential to a vigorous plant growth, and so are, to that extent, deficient as a perfect fertilizer, and will usually be more effective when composted with stable manure, cotton seed, or some other vegetable matter. The well known "Furman's Formula" is one of the best forms of compost, and is made by using 750 pounds each of stable manure and cotton seed with 367 pounds of acid phosphate and 133 of kainit. For use on soils which are deficient in lime, as in the extreme northeastern corner of the state, and in nearly all of the state lying south of the Vicksburg and Meridian Rail Road, these seem to be the best proportions which can be used. In the region where the soil is already rich in lime, as in nearly all of the northern part of the state, we have found it better to reverse the proportions of acid phosphate and kainit, or even to omit the phosphate altogether and replace it with an equal weight of kainit, or half the amount of hull ashes. The cost of either of these composts will be about five dollars per ton, and for the first year not more than five hundred pounds per acre need be used. As the land improves in condition larger amounts can be assimilated, and the application should be increased five hundred pounds yearly so long as it produces a corresponding increase in the crop. Furman claimed to have found it profitable to use at least four tons per acre, and that by its use he increased the yield of cotton from less than one-fourth of a bale to more than three bales.

Both the regular Furman mixture, and the mixture in which the acid phosphate was replaced with kainit, have been used on the yellow clay loam of the Station farm, for four years, and in every case the results have been in favor of the mixture containtaining the larger amount of kainit. The soil here is rich in lime, and the average yields during the four seasons have been:

Unfertilized Plots	435	lbs. per	Acre.
250 pounds Acid Phosphate	423	"	"
250 " Kainit	721	"	"
Furman's Formula, Regular	810	"	"
" " Acid Phosphate replaced by Kainit	1174	"	"

Results almost the reverse of these have been secured during the three years of work at the branch station at Lake, which is in

the pine woods region on a soil poor in lime. There the fertilizers used and yields secured have been:

Unfertilized Check Plots	Yield 614 lbs.
35 bushels Cotton Seed, or 200 pounds Meal 200 pounds Kainit	" 846 "
35 bushels Cotton Seed, or 200 pounds Meal 200 pounds Acid Phosphate	" 1253 "
35 bushels Cotton Seed, or 200 pounds Meal 200 pounds Acid Phosphate 200 " Kainit	" 1105 "
50 bushels Cotton Seed 400 pounds Acid Phosphate 200 " Hull Ashes	" 1169 "
100 bushels Cotton Seed 200 pounds Acid Phosphate (Two years) 200 " Hull Ashes	" 1249 "

The results of the work at Lake have been more uniform and constant than at either of the other stations where similar work has been done, and indicate very plainly that, for such soil, no potash is needed in addition to that supplied in the cotton seed; that 200 pounds of acid phosphate will produce a large increase in the yield, and apparently as great an increase as will be secured by double the amount. The plots receiving potash and cotton seed showed an increase of 232 pounds over the yields of the unfertilized check plots, but this increase may reasonabiy be credited to the application of the 35 bushels of cotton seed, while the average yield of all the plots which received acid phosphate was 1194 pounds.

At the Holly Springs branch station, though similar work has been continued through four seasons, the results are far from being decisive, and show very plainly the necessity for continued repetitions and duplication before any final conclusions can be drawn. In some of the series acid phosphate has appeared decidedly superior to kainit, while in other series, on what appeared to be similar soils, kainit has given much the better results. In nearly every case, however, a mixture of cotton seed meal with the chemical fertilizer used has been highly advantageous, while meal alone has seldom been as profitable as have been some of the mixtures and composts.

So far as can be seen from the work done, the upland clay soils of that region will be fertilized most economically by the use of either meal or compost to furnish vegetable matter and nitrogen, and to these should be added both phosphoric acid and potash, more of the latter than the former being needed. For the sandy valley lands cotton seed meal seems the best foundation for the fertilizer, and to that should be added more phosphoric acid than potash, though both are needed.

Whether commercial fertilizers and composts should be applied broadcast or in drill depends principally on the amounts

used. When the amount is small, we have secured the best results by placing it in the drill; and when a second application is to be made during the growing season the first should always be in the drill. When the application is large, and is of such materials as acid phosphate, ground bone, or hull ashes, all of which act more slowly than do meal and the ordinary commercial brands, we have found it to be fully as well to make the application broadcast. When fertilizers are put in the drill before planting, care must be taken to have them thoroughly mixed with the soil as, if left in bulk, the young roots are sure to be burned and withered as soon as they reach it. Any ordinary amount can be mixed with the soil by running a bull-tongue along the rows after the fertilizer is applied. When a second application is made it should be followed at once by a cultivator to mix it with the soil.

At neither the home station, nor at either of the branch stations have as good results been secured by the use of commercial fertilizers alone, as when they have been used in connection with a liberal amount of vegetable matter. Humus is just as necessary to a fertile field as is potash or phosphoric acid, but a soil which is rich in humus will often give a much larger yield if stimulated and assisted by the addition of other materials. Lands may be built up and kept in good condition by the use of stable manure, cotton seed, and green manuring, but the same results may be secured at less expense if these are supplemented by a judicious use of chemicals.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 30.

A KEROSENE ATTACHMENT FOR KNAPSACK PUMPS.

HOWARD EVARTS WEED.

AGRICULTURAL COLLEGE, MISS.,

MAY, 1894.

The bulletins of the Station are sent free of charge to all farmers in Mississippi who apply for them.

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A KEROSENE ATTACHMENT FOR KNAPSACK PUMPS.

In Bulletin 27, of this Station, a description is given of an attachment to the Climax pump of the Nixon Company, whereby kerosene is mechanically mixed with water for use as an insecticide. This attachment to the Climax pump was designed by Prof. E. S. Goff, of the Wisconsin Station, and published by him in the Annual Report of the Wisconsin Station for 1891. The attachment as here described is that as applied to the "Perfected Galloway" Knapsack, of The Deming Company. As applied to the "Perfection Knapsack Sprayer" of the W. & B. Douglass Company, it differs only in one or two details, both attachments doing equally satisfactory work.

An exterior view of the outfit is shown in Fig. 1. The kerosene is placed in a separate tank, which is attached to the back of the main tank by means of two clips at the side near the top and holds one and one-fourth gallons. A one-fourth inch hose, attached by a collar, connects the kerosene tank with a brass pipe connecting with the cylinder of the pump just below the lower of the two small balls which serve as valves. A stopcock is provided, as shown in the figure, so that the kerosene, or a portion of it, can be shut off at any time. Fig. 2 shows the attachment more in detail, and but little is needed by way of further explanation. A pipe for the passage of the water is provided, at right angles to the pipe through which the kerosene passes, and this is also provided with a stopcock with an elongated handle extending through the top of the main tank, as

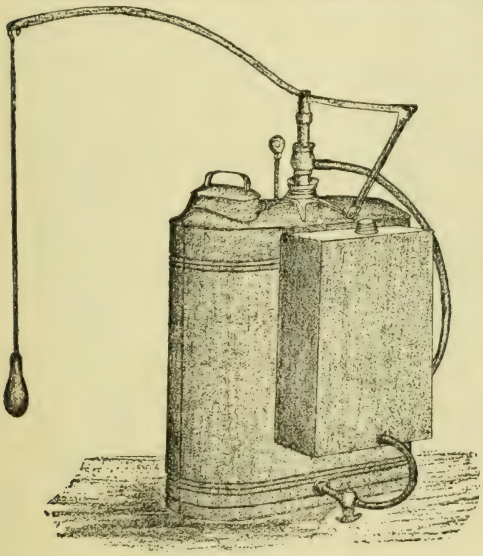

FIG. 1.

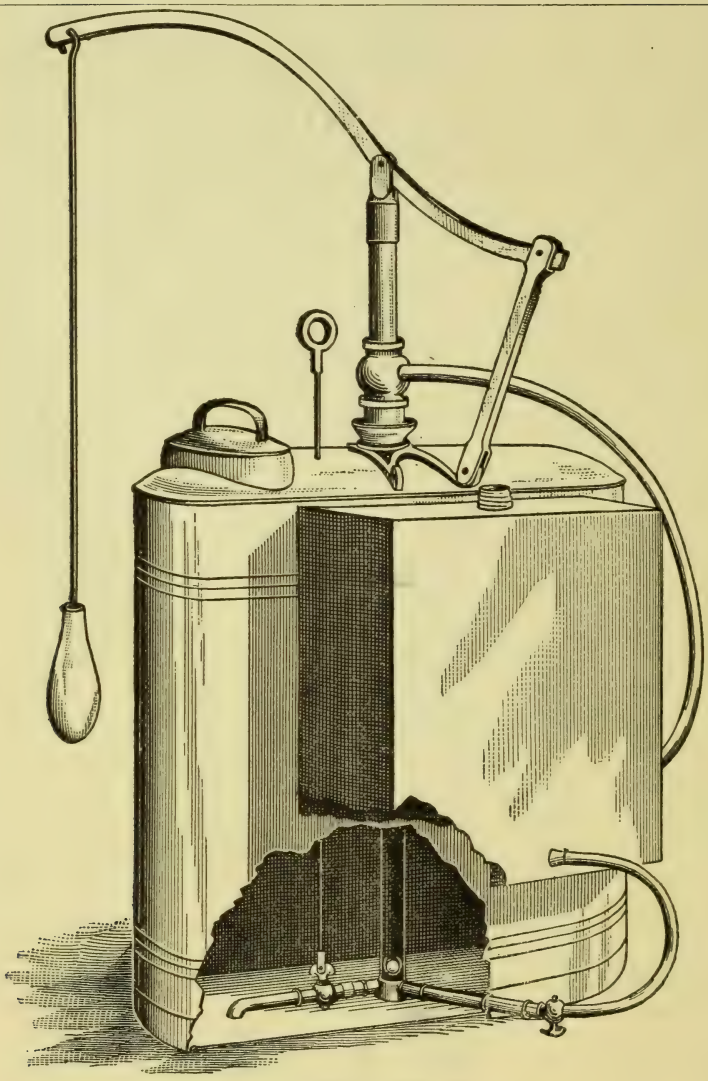

FIG. 2.

shown in the illustration, so that the water may be shut off if desired. Owing to the action of kerosene upon rubber, the small rubber balls which serve as valves at the bottom of the pump cylinder, should be replaced with marbles.

The hose connection between the kerosene tank and the pump should be of cloth insertion, so that it may last longer than would be the case if composed of rubber alone. It will occasionally be necessary to put on a new hose connection here, which is easily done. The kerosene tank can be made of tin, unless wanted for corrosive compounds, as explained later, and is readily detachable from the pump proper, so that when the pump is used for purposes other than where a mechanical mixture of two liquids is wanted, it will in no way interfere with the use of the pump in the ordinary manner.

The mechanical mixture of kerosene with water is designed to do away with the necessity of making a kerosene emulsion. Kerosene is an excellent destroyer of insect life, and by its use many insects can be destroyed which could not be reached in any other way. Heretofore the kerosene has been made into an emulsion by first mixing with soapsuds or sour milk and then diluting with water, as it cannot be used in an undiluted state on plants on account of its injurious effects. While it has been used as an insecticide very successfully in the form of an emulsion, yet various writers have reported far different results from their attempts in making a stable emulsion. It would seem that different conditions as to the kind of soap and water used, temperature, mode of operation, etc., so effect the making of the emulsion that the same results are not always obtained even by the same person when working under what might be considered the same conditions. Such being the case, if by the mechanical mixture of kerosene and water we can accomplish the same results obtained by an emulsion, we have greatly simplified the matter so that it will be used as an insecticide much more extensively. Kerosene is wanted for use as an insecticide most extensively in garden work and for such purposes the knapsack pumps are used almost exclusively. It is on this account that we have fitted the attachment to these pumps. By means of this attachment any proportions of kerosene and water desired can be pumped from the nozzle by simply turning the stopcocks. Both stopcocks can be reached with the hand when pumping, although for ordinary purposes it is only necessary to turn the cock of the kerosene pipe, this being the more easily reached.

Experiments with this attachment show that the kerosene and water are so thoroughly mixed in the act of pump-

ing that the kerosene is as harmless to foliage as is an emulsion of the same strength, and upon all plants so far as we have experimented we have been enabled to kill the insects without injury to the foliage. We have been especially successful in using the attactment upon the green Cabbage-worm (*Pieris rapæ*) and the Cabbage aphis (*A. brassicæ*), the proportion of kerosene used being about one-tenth. For the Cattle Tick (*Boophilus bovis*) we have used the attachment successfully by using equal amounts of kerosene and water.

This attachment can also be used for many purposes other than the mechanical mixture of kerosene and water. In many cases it may be best to dilute fungicides only when applied to the foliage in the act of pumping and for this purpose it will prove useful. A recent report (Delaware Station, Bulletin 22) recommends this method as being the most efficient in the preparation and use of the ammoniacal solution of copper carbonate. Of course when the copper or other corrosive compounds are used in this manner, the small tank should be made of brass instead of tin.

This attachment for the knapsacks can be obtained from The Deming Co., Salem, O., in connection with their "Perfected Galloway Knapsack," at eighteen dollars, and from the W. and B. Douglas Co., Middletown, Conn., in connection with their "Perfection Knapsack Sprayer" at the same price. These pumps with their attachments are of about equal value, both being of the same pattern and differing only in details.

SUMMARY.

1. By means of an attachment to the knapsack pumps we are now enabled to mechanically mix kerosene with water for use as an insecticide.
2. This mechanical mixture appears to do all the work of a kerosene emulsion, thus greatly simplifying the method of applying kerosene as an insecticide.
3. This attachment is applicable to all the knapsack pumps of the Galloway pattern, and can now be obtained in connection with the "Perfected Galloway" and the "Perfection" knapsacks.
4. As this attachment is not patented, all manufacturers are at liberty to place it upon their pumps.
5. The attachment can also be used for many purposes where a mechanical mixture of two liquids is wanted.

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Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 31.

Lameness in Horses and Mules.

TAIT BUTLER.

AGRICULTURAL COLLEGE, MISS.

SEPTEMBER, 1894.

The bulletins of the Station are sent free of charge to all farmers in Mississippi who apply for them.

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LAMENESS IN HORSES AND MULES.

The purpose of this bulletin is to set forth in plain terms a sufficient number of facts and principles to enable the stock owner, who cannot secure the services of a competent veterinarian, to locate and treat intelligently the most common forms of lameness. It is not expected that he will be able to locate all cases of lameness, nor is it the intention of the writer to discuss all the diseases affecting the organs of locomotion, but it is believed that if the following directions be carefully studied many of the serious mistakes now made in the diagnosis and treatment of lameness will be avoided.

GENERAL INDICATIONS OF LAMENESS.

It is always well to observe the animal while standing at ease, for when undisturbed it is apt to show in a more or less definite manner any soreness which may exist. In fact, the first manifestations of a condition which may in time result in lameness are frequently observed while the animal is standing quietly. If a horse rest either front foot, even slightly, while standing squarely with his weight upon the other three feet it is always sufficient to arouse a well founded suspicion of soreness in the rested member. If however, he rest a front and a hind foot of opposite sides it may indicate nothing more than a little carelessness. Again, it is necessary to observe the first movements of the animal after he has been standing for some time, for in the first stages of certain forms of lameness the only evidence of disease may be exhibited in the first few steps that the animal takes.

When the foregoing observations have been made and carefully noted it is always advisable to see the animal in more rapid motion, but it is a mistake to excite him or make him go too fast, for if he be only slightly lame any excitement may cause him to travel without showing any lameness. The best conditions under which to observe the lameness is a slow trot on a hard road, with

the head unrestrained. That is, the horse should not be reined up, nor should there be any person on his back, but if he be led with a loose halter at as slow a trot as possible, the first conditions will have been obtained. In determining the location of the affected part the first point is to ascertain whether it be in a front or hind leg. This seems a simple matter but where the animal is only slightly lame the novice frequently makes a mistake. If the lameness is in a front foot, and the animal is trotted away from the observer, it may appear to be in the opposite hind foot, owing to the fact that these feet come in contact with the ground at nearly the same time. If however, the observer takes the care to have the animal brought towards him as well as moved away he will readily detect the difference by the fact that the lameness will appear greater when the diseased member is nearer to him.

The next point is to determine whether the lameness is in the left or right foot. This may always be done without difficulty if the lameness be severe, but if only slight the inexperienced may readily make a mistake. If the following rule be remembered no trouble will be experienced in this case. When the lame foot comes in contact with the ground it will be quickly jerked up and this movement will give a more or less decided upward movement to the head if it be in a front leg, and to the hip if it be in a hind leg. Also, when the well foot comes to the ground the weight will be fully thrown upon it and there will be a decided dropping of the head or hip as the case may be.

Having ascertained which limb is affected the next and more important, as well as more difficult point, is to definitely locate the disease. For some unknown reason those not very familiar with the subject almost invariably locate what to them appear obscure cases of lameness, in the shoulder, hip, or stifle. In fact, however, these parts are much less frequently affected than many others. The reason for this misconception is difficult to ascertain, but of this we may be certain, that ninety per cent of the lameness seen in horses and mules is in the knee or some part below it. This may be explained by the fact that the bones farthest from the body meet each other in a more nearly vertical line, and are smaller, which increases the weight and concussion

on any given point and thereby renders it more liable to disease. Those parts at a distance from the body are also more liable to strain. The following general rules may be given to aid in locating lameness and will at least be of considerable service in distinguishing lameness above the knee or hocks from that in those joints, or below them. If an animal places one front foot in advance of the other, even slightly, for the purpose of resting it and stands squarely upon the other three feet we may infer that the lameness is either in the knee or below it. If the lameness be in the region of the shoulder joint the foot will probably be placed with only the toe on the ground back of the other foot, the leg hanging somewhat loosely in a bent or flexed position. If in the region of the elbow joint, that is, the one between the knee and the shoulder, the leg will be held in the same general position, but the toe usually rests on the ground opposite the other foot. Again, if the lameness be below the knee the animal will, in moving the diseased member, extend it well forward and bring the other up to it or only a short distance in advance; while in high lameness the lame member will not be advanced much in front of the well foot, and consequently the long step will be taken with the well leg, which is the opposite of what occurs in low lameness.

These characteristic actions will usually be plain when the lameness is well marked but will be less plain as the lameness is less severe. In fact, when the lameness is slight, only the eye of the expert will be able to detect the differences of action.

It should be remembered that the locating of lameness is largely a process of elimination; that is, the absence of any indition of lameness in any other part of the leg may be negative evidence of as much value as the positive signs of the disease.

FOOT PUNCTURE.

One of the most common causes of lameness is puncture of the sole of the foot. It is caused by the animal stepping on a nail or other sharp object. The puncture is most likely to occur in the neighborhood of the frog, or where the sole and wall of the foot join, but it may occur in any part of the sole. When the nail comes in contact with the horn of the sole it is likely to

glance until it meets the projection of the wall or the softer rough frog; hence the greater frequency of puncture in these localities.

Symptoms.—Since the nail usually pulls out, and the horn springs back to its former position so as to close the opening the nail made, there is sometimes difficulty in locating exactly the seat of the wound. As a result of this many an animal has been made to stand on a lame foot by a stifle shoe having been put on the well foot. Locating this sort of lameness in the stifle joint is a common but inexcusable error, as the action resulting from lameness in the two parts is entirely different. The so-called "gravel" which is said to enter the sole of the foot and then "work out" at the heel is usually the "working out" of the pus or the matter resulting from a nail puncture or a bruise. If an animal becomes suddenly and severely lame and there be no evidence of any thing in any other part of the leg, such as swelling, heat, and pain upon pressure, it is always well to look for puncture in the foot. If the animal stands with the lame foot extended and when walking places the lame foot well forward and brings the well foot up to it, the evidence of puncture is still stronger. To examine the foot properly the shoe should be removed. It is not sufficient to merely scrape the bottom of the foot clean, for if the nail has pulled out and the horn sprung back in position, all trace of its entrance may have been obliterated. To examine the foot properly a pair of large pincers or a hammer is necessary. The former is the better, as by compressing the hoof the exact spot may be found, while tapping the sole with a hammer may cause the animal to evince pain even though the tapping is not directly over the injury; but with a little care the spot may be definitely located with either instrument. If the injury is of a few days standing additional heat in the hoof and perhaps slight swelling of the pastern may also be present.

Treatment:—When the point of the puncture has been ascertained the horn should be pared out so as to leave an opening for the escape of all matter. This opening need not be larger than an ordinary sized lead pencil. The practice of burning out this hole with a hot iron or by the use of caustics is very objectionable and useless. A solution of carbolic acid (one part of acid to

twenty-five of water) may be used to wash the wound. If the animal be kept in a clean place, and the wound washed once a day with the same solution, a rapid recovery is usually the result. In case where the lameness is severe, a poultice of wheat bran or linseed meal may be applied for a day or two, but should not be kept up for a longer period.

In those cases where the lameness subsides, but luxuriant granulations of "proud flesh" spring up and fill the opening in the horn, they may be cut down by a hot iron to a point level with the inner or deeper surface of the horny sole. Then the cavity should be filled with balsam of fir, a pad of cotton placed over it, and over all a piece of good firm leather which may be held in place by a shoe. The main point in the treatment of nail puncture of the foot is to give free exit to all matter that may collect, and keep the part as clean as possible. If this be done, the matter will not be compelled to work out at the heels, and no separation or loss of hoof will occur.

FOOT EVIL.

"Foot evil" is the name popularly given in Mississippi to a disease of the coronet or that region of the foot where the hoof and skin meet. It is an inflammatory condition which sometimes results in the separation of the hoof from the soft structures to such an extent that the hoof is lost.

Causes.—It is chiefly the result of filth, moisture, or both. At least, these are very favorable to its development and it is seldom or never seen under any other conditions. The irritation produced by manures, mud, or heavy dews, will result in developing foot evil.

Symptoms.—These are slight swelling, lameness of a more or less severe type, and a progressive separation of the outer part of the horn and soft structures, which usually begins at the heels and extends forward until it encircles the whole foot.

Treatment.—Remove the cause; that is, keep the parts dry and clean. Apply a little strong liquid carbolic acid to the affected part by means of a feather, and then apply a solution of carbolic acid (one of acid to twenty-five of water) once a day. If a marked improvement is not noticed in three or four days apply the pure acid again and then continue the solution as before.

LAMINITIS (FOUNDER.)

Laminitis, or founder as it is commonly called, is an inflammation of the sensitive laminæ or soft structure between the hoof and bones of the foot. The popular belief that founder is in the legs and chest is an error. The disease is in the feet, and those symptoms which make it appear as a stiffness in the legs and shoulders are but the natural results of soreness in the feet.

Causes.—While we may not be able to give a satisfactory explanation of the fact, we are none the less certain that any irritation of the digestive tract, or in fact, any extensive irritation of any mucous surface may produce an inflammation of the sen sitive laminæ of the feet. Therefore laminitis may be produced by a change of food or excessive feeding, a change of work or excessive work, large quantities of food or water when warm or fatigued, sudden changes of temperature such as cooling too fast when sweating, and a long drive on hard roads, especially without shoes. Excessive purging or diarrhoea may also produce it. Laminitis occasionally results from the irritation of foaling, but this is not common.

Symptoms.—Founder may occur in the fore or hind feet or in both; but generally the fore feet are those affected A stiffness and disinclination to move are perhaps the first symptoms noticed. There will be a decided elevation of temperature of the body while the force and frequency of the pulse will be increased. The normal temperature of the body of the horse is from 99 to 100 degrees F. while the pulse is from 36 to 40 beats per minute. The best place to take the temperature is in the rectum, and the pulse can best be felt on the lower and inner part of the lower jaw at about the centre as regards distance from before backwards. The position in which the animal stands is characteristic. The fore feet will be placed well forward so that the weight will be borne by the heels, while the hind feet are brought well up under the body in order to take as much weight off the front feet as possible. This position gives a rather unsteady appearance to the animal and the hind feet are frequently shifted in order to maintain as steady a position as possible. From this fact founder is frequently mistaken by inexperienced

persons for a disease of the kidneys. An increase of heat in the feet with a manifestation of pain when the hoofs are tapped with a hammer are, when taken with the foregoing, satisfactory evidences of founder.

Treatment.—Remove the shoes and apply moisture to the feet. The latter may be done by standing the animal in water five or six inches deep each day, several hours at a time, or by the application of a poultice of wheat bran or flax seed meal. The poultice may be applied by the use of a sack large enough to envelope the foot and hold sufficient of the poultice to retain the moisture for some time. This application of moisture to the feet should be continued until the severity of the inflammation and lameness have subsided.

Unless the founder be due to excessive purgation a quart of linseed oil should be given as a purgative. During the first forty-eight hours from thirty to forty drops of tincture of aconite may be given every three or four hours. One ounce of nitrate of potash (salt peter) should also be given three times a day in the feed or on the tongue. If the lameness continues after the acute symptoms have subsided a rest of several weeks on a soft pasture and the application of a blister around the top of the hoof may be recommended.

The following mixture has been found useful as a blister:

Red Iodide of Mercury, 1 part.
Lard, 4 part.
Cereate of Cantharides, 4 part.

Apply around the top of the hoof, except at the heels, and rub well for ten or fifteen minutes. The animal should be tied so that it cannot get its mouth to the blistered part for several hours.

RING BONE.

There are two joints in the leg of a horse below the fetlock joint. The upper is known as the pastern, and the lower as the coffin joint. The latter is enclosed by the upper part of the hoof while the former is between the top of the hoof and the fetlock joint. Ring Bone may affect either of these joints. It is a bony enlargement resulting from an inflammation in the bone or its

covering, the periosteum. An inflammation in any part of the body results in an oozing of blood from the vessels into the surrounding tissues and consequent swelling. If this exudation is in bone tissue it is likely to be converted into bone on the same principle as a callous forms in soft tissue. The deposit of bone tissue around the joint and sometimes in the joint is usually in the form of a ring, and hence the name "Ring Bone."

Causes.—There is scarcely any doubt that a predisposition to certain diseases of the bones may be transmitted from parent to offspring. Experience and observation has taught this, and heredity plays an important part in the causation of ring bone, in the matter of a faulty conformation of the legs. A short straight pastern, and an unusually long and oblique one, are equally objectionable. The former because the concussion or jar is thereby increased and the latter because of the greater strain put upon the parts. Any direct injury, such as a kick from another animal, or a blow of any sort in any of these joints, may result in ring bone, but the most common cause is perhaps a strain. It is also produced in young colts by the toes being allowed to grow too long, or by the hoof becoming uneven on the ground surface from insufficient and irregular wear, thereby throwing unequal pressure or weight on the parts.

Symptoms.—Ring bone may occur in any of the legs but the hind legs are more frequently affected. The lameness which is usually the first indication of the disease is not entirely characteristic. It is usually more or less intermittent, and is especially marked after the animal has been subjected to very severe labor. This however is not of much diagnostic value as the same conditions occur in other forms of lameness. Bending the foot backward and forward and from side to side, and at the same time putting pressure on the parts with the hand, is likely to produce evidence of pain. As the disease advances an enlargement may usually be seen. This is best seen by standing in front of the animal and comparing one leg with the other. If the lower joint be affected a bulging of the upper part of the hoof will occur. An increase of heat in the part will also usually be perceptible.

Treatment.—The hoof should be the first to receive attention. It is important that the foot should be leveled so as to properly

throw the weight of the animal on those parts intended to bear it. A long toe, or one side of the hoof decidedly higher than the other, are frequent causes of ring bone and therefore must not exist if the treatment is to be of service. A rest of three or four months is an essential, and it is not sufficient to turn the animal on pasture, but he should be kept as near absolute quiet as possible. It is a fact which should not be lost sight of that those who have the best success in treating lameness are those who are most successful in securing a long rest for their patients.

A blister should be applied to the enlargement every two or three weeks for several months, and for that purpose perhaps nothing is better than

Red Iodide of Mercury, 1 part,
Lard, 4 part.

These should be thoroughly mixed and applied with smart friction after all the hair has been removed from the parts.

The head of the animal should be tied up for eight or ten hours after the application of the blister and then a little lard may be applied to the blistered surface This application of lard may be repeated every two or three days until the next blister is applied. The line of treatment which has probably met with the greatest success is that of puncturing the enlargement with a red hot iron about the size and shape of an ordinary lead pencil when well sharpened. The punctures should be about one inch apart, and while they may be deep, they should not open the joints nor wound other important structures. This "firing" may be repeated in six or eight weeks if sufficient improvement has not been made. After the firing the parts should be greased every two or three days with carbolized oil or petrolatum (one part of carbolic acid to fifteen of lard or petrolatum) until the wounds thoroughly heal. The enlargement cannot be removed by any means that is safe, but if the lameness is cured may be gradually absorbed to a considerable extent. Ring bone is a serious affection and the treatment has been by no means uniformly successful. If however, the animal be young and the disease be in its first stages, a recovery sufficient for slow work may usually be expected.

SPLINT.

A "splint" is a bone tumor which usually occurs on the inner side of the fore leg a short distance below the knee. It may come on the outer side of the fore leg, or it may come on the hind leg, but such cases are rare. Splints are of the same nature as ring bone and owe their existence to much the same causes. Young horses that are put to driving on hard roads before the bones are fully matured are especially likely to suffer from them.

Symptoms.—The action of an animal is characteristic. It is rare that any lameness can be detected when the animal is walking, but when trotting the lameness will be well marked, especially if the ground should be very hard and a very decided dropping of the head when the weight is thrown on the well foot will be noticed. With this action, if an enlargement can be detected in the region of splint, a diagnosis will be easy. Sometimes however, lameness is present before the appearance of the bony tumor and then the character of the action must be depended upon as a guide to direct diagnosis.

Treatment.—If the splint produces no lameness, and is sufficiently distant from the knee not to be likely to involve that joint, no treatment is justified. If lameness be present, a rest for a few weeks and the treatment suggested for ring bone, will usually effect a cure for the lameness, unless the knee joint be involved, in which case it may be permanent. After the lameness subsides the tumor usually becomes smaller and in a few years may disappear entirely.

BONE SPAVIN.

The hock joint is probably more liable to diseases than any other part of the hind leg, and one of the most common diseases of this joint is bone spavin. It is usually located at the lower part of the inner side of the joint, but may involve any part of the hock.

In nature it is almost identical with the other bony diseases, ring bone and splint.

Causes.—The conformation or shape of the hock joint plays an important part in its freedom from, or liability to, disease.

As this conformation is due largely to inheritance, heredity is an important factor in the causation of bone spavin. A hock joint, the lower part of which is small, especially if it be cut out, as it were, in front, is certainly predisposed to disease. In this faulty hock, as to conformation, any strain or direct injury is likely to set up such an inflammation as will result in spavin.

Symptoms.—When the bone tumor precedes the lameness the diagnosis is made more easy. The enlargement is most readily seen by the observer taking a position in front and a little to one side of the animal. By stepping from one side to the other and comparing the two joints, even a very small enlargement may be detected. The precaution must be taken however to see that the animal stands squarely on both feet, and that they are even with each other. It is a good practice to stand behind the animal and compare the two joints from that direction also.

While the eye will probably detect an enlargement more certainly than will the sense of touch, yet both should be used. Of course there might be bone spavin and the horse be lame in some other part also, but that is a possibility always to be considered in making a diagnosis. If no bone tumor is present the diagnosis of spavin is still possible if the more or less characteristic action of spavin lameness be known. The peculiar action of spavin lameness is rather difficult to describe, but when once fully recognized is not readily mistaken. The best plan for any person who desires to become familiar with it is to watch closely some animal known to be lame with the disease. A very peculiar rise and fall of the croup will be noticed, and a very distinct "hitch" in the gait.

The lameness is apt to be intermittent; that is, at first it will only appear at irregular intervals, or only when the animal is first started up after standing for some time. A few hours after a long drive or hard work the lameness will be much more severe. The horse is said to "drive out" of spavin lameness; that is, while quite lame when first started, if driven a distance the lameness nearly or entirely disappears. Pressure on the enlargement may in some cases cause manifestation of pain, but this is by no means common. Increased heat in the part would be evidence of the location of lameness.

Treatment.—A rest for three months, and the treatment prescribed for ring bone, will probably give the best results. The blister will not be found as effective as the firing and hence the latter is preferred for bone spavin.

LUXATION OF THE PATELLA (STIFLE).

In the stifle joint of the horse is a small bone resembling the knee cap in man. A slipping of this bone to one side out of the groove in which it works is what is called "luxation of the patella" by veterinarians and "stifle" by horsemen. It is most common in young animals because of the greater freedom of the joints which exists during early life, but it may occur in older animals. In colts it may result from a relaxed condition of the ligaments which hold the bones in position, without any marked inflammation. In other cases, especially in older animals, it is due to some direct injury to the part or to a strain, and in such cases is accompanied by more or less inflammation in the parts; young colts that follow their dams, that are driven a good deal, or that run on a hilly pasture, are more liable to the trouble.

Symptoms.—The action is so peculiar that when once seen can never be forgotten or mistaken. When the leg is thrown backward the patella slips to the outside of the groove in the thigh bone and the muscles that are attached to it are unable to exert their function to bring the leg forward. The case is similar to a rope slipping off a pulley. The result is that the animal cannot bring the leg forward and the toe remains as if fastened to the ground. For some reason nearly every animal that goes lame in the hind leg is thought by most people to be "stifled." This is a great mistake, for the trouble is by no means as common as are many other forms of lameness.

Treatment.—In most cases the bone will slip back in place of itself, and cause trouble only at intervals. This is usually the case in colts, and in them the trouble will generally disappear as they grow older.

The colt should be prevented from taking too violent exer-

cise and a blister applied occasionally to the region of the stifle joint. For this blister the following may be used:

Cereate of cantharides, 8 parts,
Red Iodide of Mercury, 1 part,
Lard, 4 parts.

Mix thoroughly and use as directed for other blisters in this bulletin. If the bone does not return to its proper position of itself it may usually be reduced in the following manner: Put a rope around the fetlock and draw the foot forward, at the same time put considerable pressure on the displaced bone with the hands. The bone will usually slip back into position if this process be persisted in. When returned it may be kept there by preventing the leg from being extended backward. This can be done by fastening a rope around the fetlock and attaching the other end to a collar around the neck. This rope may be held up out of the way by a circingle around the body. The horse must be kept quiet and a blister applied to the joint every two weeks until two or three blisters have been applied.

STRAINS.

It would be impossible in a bulletin like this to describe all the different parts which may be strained or sprained sufficiently to cause lameness, and therefore the subject may be treated in a general way.

Causes —Unusual and very severe work are common causes, but the uneven surface of the roads upon which this work is done is perhaps responsible for the greater share of such accidents. If an animal slips, or treads on an uneven surface when pulling a heavy load, or is going very fast, there is great dauger of such an accident.

Symptoms.—Lameness is usually accompanied by swelling which can be seen by looking the leg over closely and comparing it with the sound leg. Pressure over the strained part will cause the animal to evince pain, and therefore every part of the affected leg should be manipulated. There will also be an increase of heat in the part injured.

Treatment.—During the first or acute stages the strained part should be bathed thoroughly for an hour or two, three times a day. The action of warm and cold water is practically the same, and so either may be used, though the former is preferable in winter and the latter in summer. After bathing rub dry and apply

Fluid Extract of Belladonna, one ounce,
Dilute Alcohol, seven ounces.

Mix and apply three times daily. Bandages will be valuable for parts of the leg to which they can be applied.

After the acute inflammation has subsided, if any soreness and swelling still remain, the following liniment may be used:

Tincture of Iodine, one ounce,
Spirits of Camphor, two ounces,
Dilute Alcohol, five ounces.
Mix and apply twice daily, with smart friction.

In the chronic or later stages repeated blistering is perhaps the best treatment.

It must be remembered that, in treating strains and lameness of all kinds, perfect rest is absolutely essential to complete recovery.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 32.

A NEW KEROSENE ATTACHMENT FOR KNAPSACK SPRAYERS.

HOWARD EVARTS WEED.

AGRICULTURAL COLLEGE, MISS.,

DECEMBER, 1894.

The bulletins of the Station are sent free of charge to all farmers in Mississippi who apply for them.

A NEW KEROSENE ATTACHMENT FOR KNAPSACK SPRAYERS.

In Bulletin 30 of this Station is described an attachment to the knapsack pump, by means of which kerosene can be mechanically mixed with water for use as an insecticide. As originally designed, (See Report of Wisconsin Station, 1891) an attachment was placed on an orchard pump, but realizing that kerosene is wanted more largely in garden work we designed an attachment for a knapsack pump, that pump being the one best adapted for garden work. Experiments made last season showed that the attachment did good work in the hands of a careful person, but experience in the field showed that slight modifications would make the proportions of the mixture more exact, the adjustment more simple, and the pump better for general use. The attachment, as now made, is described in the following pages.

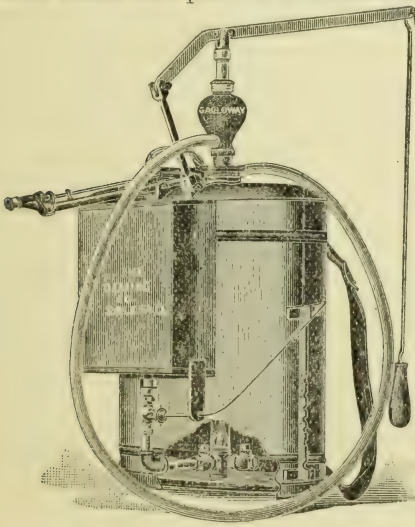
The accompanying illustration shows the attachment as now made by the Deming Co., of Salem, Ohio, in connection with their "Perfected Galloway" Knapsack Sprayer. The kerosene is placed in a separate tank holding one gallon, and which is attached to the main tank by means of clips. A brass pipe connects the kerosene tank with the bottom of the pump in the center of the main tank, and a check valve is placed in the kerosene pipe just inside the main tank, with a second valve through which the water passes, at right angles to this. These check valves permit the passage of the kerosene and the water into the pump, but prevent any mixture of the liquids except while pumping.

A stopcock is placed in the connection between the kerosene tank and the pump, and attached to it is a rod bent around to the side of the main tank where it fits into notches on a gauge, as shown in the illustration. When the rod is placed in the bottom notch the stopcock is closed, and when in the top notch it is fully open, and when in the latter position equal parts of kerosene and water are used.

The notches on the gauge plate are marked to indicate the proportion of kerosene which is being used, as follows:

5-10
4-10
3-10
2-10
1-10
1-15
1-20
1-30
0

Thus, when one part of kerosene to twenty-nine of water is wanted, the rod is placed to the notch marked "1-30," and when one part of kerosene to nineteen of water is wanted, the rod is placed in the notch marked "1-20," and so on. The rod may be changed from one notch to another at any time, even while pumping, and is held firmly in place until changed by the operator.



When the stopcock is changed from one proportion to another, the last proportion indicated will not be secured until a few strokes of the pump have cleared the mixture already in the cylinder and pipes. The working of this attachment is very simple; the main tank is filled with water, and the smaller tank with kerosene, the gauge rod is placed in the notch corresponding to the amount of kerosene wanted in the spray, and the pump worked in the usual manner. The kerosene attachment can be readily detached from the main tank when the pump is wanted for ordinary purposes.

USES.

Insects that eat leaves can be killed by spraying or dusting the leaves with Paris green and similar poisons, but all insects which suck the juices of plants or the blood of animals can be killed only by the application of some

substance like kerosene directly to the insects themselves. Although poisons like Paris green are not applicable to insects which take their food by sucking, yet an external irritant, like kerosene, is applicable to all, and it matters not how they take their food. Kerosene can be used against all insects except those living in confined places where they cannot be reached, such as tomato worms, those living in stored grain, etc. The amount of kerosene which should be used will vary with the kind of insect to be treated, some requiring a much larger proportion than others. Nearly all plants will bear one part of kerosene to ten of water, but when a stronger application is to be made, it should first be tested on a few plants to see if the foliage is affected. For the treatment of ordinary insects the following proportions are recommended:

Plant-lice, of all kind, 1-20.
Caterpillars or other larvæ exposed on leaves, 1-15.
Scale insects on leaves, 1-10.
Scale insects on bark, summer treatment, 2-10.
Scale insects on bark, winter treatment, 3-10.
Lice on domestic animals, except hogs, 3-10.
Lice on hogs and ticks on cattle, 5-10.

The mixing of the two liquids takes place partially in the pump, but more largely in the nozzle, where they are divided into very fine particles. Of course a mixture made in this way is not a permanent one, nor is it necessary that it should be so. What is needed is simply a dilution of the kerosene so that it will not cause injury when applied, and the attachment accomplishes this object fully.

Heretofore, when kerosene has been used as an insecticide, it has been necessary to make it into an emulsion by mixing it with soap suds, which is a complicated operation requiring considerable care, but with this attachment no care is needed except to see that both tanks are kept filled, and the gauge rod in its proper place. The attachment adds about two dollars to the cost of the pump, but more than doubles its value.

[The writer wishes to thank the Deming Co. for favors shown while recently at their factory in perfecting the attachment, and also to state that the use of the check valves and the notches on the gauge plate were originally suggested by Mr. Wm. L. Deming.]

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 33.

CORN.

S. M. TRACY AND E. R. LLOYD.

AGRICULTURAL COLLEGE, MISS.

MARCH, 1895.

The bulletins of the Station are sent free of charge to all farmers in Mississippi who apply for them.

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CORN.

Corn is rapidly becoming one of the important crops of Mississippi, the harvest of 1894 having been 35,931,213 bushels, which is an increase of 10,114,034 over the crop of 1893, a larger increase than was made by any other southern state, and one which places Mississippi as twelfth in rank among the corn-producing states. In its work with this crop since 1888 the station has made 236 tests with different varieties, different methods of cultivation, different kinds of fertilizers and methods of applying them, and with methods of preserving the stored grain. In this bulletin is given a summary of the results secured here, together with some of the results secured in similar work at other stations.

DRILLS, CHECKS, AND BEDS.

Nearly all of the hill lands in Mississippi wash so easily that it is better to plant the corn in drills rather than in checks, in order that all the cultivation may be done at right angles to the slope of the hill. Wherever the soil is inclined to wash this is by far the better plan, but on level land, or on land which can be plowed safely in either direction, checks will permit a larger portion of the labor to be done with a mule, and will so save a large part of the hoeing, while the yield will be practically the same as when in drills.

"Bedding up" or ridging the land for each row should be avoided whenever possible, and the corn planted on a level surface. On all hill lands, and on lands which have sufficient slope to carry off the water before it has time to injure the corn, bedding is not only unnecessary, but it is positively injurious, as it exposes more surface for the evaporation of the soil moisture, and so renders the crop more liable to suffer in time of drouth. On hill lands, when the corn is planted in drills, each drill will form a slight ridge, but one which is enough to prevent the running over of wa-

ter and consequent washing in any ordinary rain, and all ridging beyond that, on such lands, is wholly unnecessary.

On poorly drained bottom lands, and on other lands where the water runs off very slowly, bedding is beneficial, and should be generally practiced. This Station has tried a number of plans for bedding and ridging corn ground, and the one which has been the most satisfactory has been to make a bed eight feet wide, or wide enough for two rows, with water-furrows in the alternate spaces. By this plan each row has a water furrow on one side of it, and that has been amply sufficient to carry off the surplus rainfall. By using this wide bed the ground is kept more nearly level for each row, the crop suffers less from drouth, and as an eight-foot bed can be made higher than one four feet wide with the same slope, the drainage is more thorough.

The station has tested these methods during six consecutive years, and does not hesitate to recommend level culture for the hill lands, wide beds for poorly drained and bottom lands, and shallow cultivation everywhere.

DEEP AND SHALLOW CULTIVATION.

Comparisons of deep and shallow cultivation have been made during four years, and the results, with a single slight exception, have invariably been in favor of the more shallow work. In all of this work we have used alternate plots in the same fields, usually three plots for each plan of work, and all the plots each year were cultivated the same number of times and on the same days. In all cases the first cultivation was given to all the plots with a Thomas smoothing harrow just as the corn was coming up, and the second cultivation was also the same for both, and consisted in "barring off" with a one-horse moldboard plow, after which the plots were hoed and thinned to a stand. Where deep cultivation was followed, the after cultivation was done with a bull-tongue when the ground was hard, and with a double shovel or a sweep when it was more mellow, the object being to stir the soil at least four inches in depth. At each working after the barring off the soil was thrown towards the rows. Where shallow culture was followed all the cultivation after the first plowing was done with a five-toothed cultivator which seldom loosened more than two inches of the surface soil. No attempt was made to throw the soil towards the rows, and the whole surface was kept as smooth and level as was possible.

A great amount of similar work has been done at other stations, and in nearly every case the results secured have been the same as here. We have examined the records of 116 such tests made at thirteen different stations and find that sixty-one tests of deep cultivation gave an average yield of 64.9 bushels per acre, while fifty-five tests of shallow cultivation gave an average of 74.7 bushels, a difference of 9.8 bushels per acre, or more than fifteen per cent. in favor of shallow cultivation. In only five cases out of the entire number did the deep culture show the better results.

Corn is a plant which has a large number of long roots near the surface of the soil, and whenever the soil is disturbed so deeply as to cut the surface roots the plant is necessarily weakened by having its supply of nourishment decreased. A constant supply of food is just as necessary to the growing plant as to the growing animal, and cutting many of the roots when the plant is growing rapidly frequently gives the plant a check, from which it never fully recovers.

Such a uniformity in results secured from so large a number of tests at so many stations is not accidental, and during the last four years we have followed the shallow culture system for our general crop. The ground is plowed as deeply as possible before planting, but after the crop begins to grow the roots are disturbed as little as possible.

CUTTING, TOPPING, AND STRIPPING.

In the southern states, where good hay can be grown so cheaply, and where the cornstalks are so large and coarse, the stalks are seldom cut for fodder, and on the majority of our farms that is the better plan. When hay becomes more scare, and we have better machinery for cutting and shredding the coarse stalks, it may be economical to use them, but under our present conditions it costs less labor to winter an animal on hay than on stalks, and cutting the whole stalks, except for the purpose of clearing the field for immediate planting in some other crop, is rarely profitable.

Many farmers practice topping the corn, i. e., removing that part of the stalk above the ears. That gives a much better fodder than when the whole stalk is taken, but still the practice is seldom profitable, and perhaps never so here, when the labor is hired by the day. The plan has

been tried at this station during three seasons, the tops being removed after the corn had become well glazed, and in every case the yield of corn has shown a marked decrease, for which the value of the tops did not compensate. The average loss in the total feeding value of the crop has been more than twenty per cent, which is somewhat larger than the usual loss from such work in the North, as the tops are worth less here than there. The records of seven other stations where similar work has been done show the average yield of the fields which were topped to have been 68.3 bushels per acre, while the untouched check plots averaged 81.3 bushels, a loss of sixteen per cent from topping. At only one station of the seven did the topped plots give the larger yield, and the average difference of thirteen bushels per acre in favor of the corn which was not topped was more than the feeding value of the fodder secured.

Stripping the leaves from the stalks, as commonly practiced in this state, is of doubtful profit. In the work which has been done at this station stripping the leaves has caused an average decrease of over eighteen per cent in the yield of corn, which has made the fodder cost $14.00 per thousand bundles besides the labor of pulling, and as the fodder could have been purchased at a cost of $10.00 per thousand, the work has not been profitable when done with hired labor. It is often the case that laborers are glad to pull the fodder on shares, the laborers and the owner each taking one half. If the crop is fully matured before this is done, it will usually pay the owner for his trouble, but the work will rarely be profitable for him when he has to hire the labor.

The results of all our work, in both topping and stripping, show that either practice is usually followed by a decrease in the yield of corn; and that the earlier the work is done the greater will be the loss; and that if the work is done so late as not to injure the grain yield, the fodder will have less value than hay costing the same amount of labor.

INSECTS.

Although there are a large number of insects which feed upon corn to a greater or less extent, there are but four which are so abundant as to cause serious injury in Mississippi. Two of these are both known as the "bud-worm" from the fact that they attack the plants soon after they germinate. One of these, which is also known as the

"corn-worm", "tomato-worm", etc., is the larva of a moth (*Heliothis armigera*) which makes its appearance in April and deposits its eggs on the young corn plants soon after they appear above the surface of the ground. Its presence may be detected very soon by the withering of the leaves of the young plants, and the worms can usually be found and killed by pinching the lower part of the stems of the wilted plants. Although it may be too late to save the plants which have been attacked, it is important that this work be done whenever the worms are numerous, as the succeeding generations of the same insect attack tomatoes and cotton later in the season, and are the same which attack the ends of the ears of the corn itself. This insect usually produces five generations yearly, and as the females of the brood which is hatched from the bud-worms frequently lay as many as 500 eggs each, it is of the greatest importance that this first brood should be destroyed. The other "bud-worm", which is also known as the "12-spotted corn root worm" is the larva of a beetle (*Diabrotica 12-punctata*), and it also lives on many other plants besides corn. There is no practical remedy for this insect, which works on both the roots and the stalk, though frequent and thorough cultivation will do much to enable the plant to withstand its attacks. The corn which escapes injury from the bud-worms usually suffers but little injury from insects until after the ears are formed, when the later broods of the one first mentioned often deposit their eggs in the ends of the ears, when they are known as "corn-worms", but if the field has been well cleared from the bud-worms there will be but little loss from the later attacks.

When the corn has matured and been placed in the crib it often suffers from the attacks of two other insects, the black weevil, (*Calandra oryzæ*), and the Angumois grain moth (*Gelechia cereallella*) Both these insects may be destroyed and their injuries prevented by the use of bisulphide of carbon. We have used this substance quite largely during the last three years, and have found it a complete preventive of loss in the crib. It costs only five dollars for a fifty-pound can, and one pound is sufficient for treating one hundred bushels of grain by simply pouring it over the top of the corn when placed in a tight crib, and then covering it for a few days with blankets or old sacks.

In addition to those insects which havs been mentioned, the chinch bug, the grass worm, the cut worm, the bill bugs

and several others are sometimes injurious, though they seldom cause serious damage. These are fully described in a bulletin soon to be issued by this station, and the insects affecting the stored grain are described in Bulletin 17. Both these bulletins will be sent to those desiring them.

EARLY AND LATE VARIETIES.

In Mississippi the heaviest yields are seldom secured from the very early maturing sorts, but more frequently from those medium or late maturing varieties which continue their growth through nearly the entire period of hot weather but which ripen fully before their growth is checked by the cool nights of October. The average yield of the varieties grown at this station which may be classed as "early" has been only 31.7 bushels per acre, while the late maturing sorts have given 41.4 bushels, a difference of nearly one-third in favor of the varieties which take the longer period for their growth. At the Illinois station the early maturing sorts have yielded about one-sixth less than the medium and late maturing sorts, but it should be remembered that the shorter growing season of Illinois permits of much less difference in time between the early and the late ripening varieties than does the longer season of Mississippi.

Although the late maturing sorts will give the larger yield, it is often the better practice to plant an early maturing variety when the field can be spared to the corn crop during only a part of the season. During three years the station has grown both wheat and corn on the same ground, the wheat being sown about the first of November and harvested about the first of June, after which early maturing corn was planted and harvested in time to follow with wheat in November. The three crops made in this way averaged 31 bushels per acre for the corn, while the wheat averaged 22 bushels. Good crops of early corn have been grown after oats, potatoes and other early crops, and the station has frequently planted early corn as early in the spring as was possible so that it could be harvested in August, when it was followed with winter oats or red clover. When the corn crop is to occupy the ground during the whole season we have found it better to use the late maturing varieties, but when it is wanted to occupy the ground for only 100 or 120 days, in either early or late summer, we have secured very satisfactory crops by using some of the early maturing sorts.

NUTRITIVE VALUES OF DIFFERENT VARIETIES.

There is a widespread belief that the yellow varieties are "stronger" i e, that they have greater feeding value than the white varieties, but we have been unable to find any foundation for this idea. Repeated analyses of the grain from both types show no marked or permanent differences, and the averages of all the analyses of which we have records are almost identical. In the "Analyses of American Feeding Stuffs" compiled by Jenkins and Winton, and published by the Department of Agriculture, the averages of 87 dent varieties and of 68 flint varieties are given as follows:

	Ash	Protein	Fiber	Nitrogen Free Ex.	Fat
Dent	1.7	11.5	2.6	78.6	5.6
Flint	1.7	11.8	1.9	79.0	5.6

Of the dent varieties of which the color is given the averages are:

	Ash	Protein	Fiber	Nitrogen Free Ex.	Fat
30 White	1.7	11.6	2.5	78.4	5.8
28 Yellow	1.8	11.5	2.5	78.9	5.4

Even the section of the country in which the corn is grown has little to do with its feeding value, the available records for dent varieties for different states being as follows:

		Ash	Protein	Fiber	Nitrogen Free Ex.	Fat
1	California.....	1.5	12.8	1.8	78.1	5.8
9	Connecticut....	1.8	11.3	1.9	80.0	5.0
2	Illinois.....	1.6	12.7	3.0	77.9	4.9
6	Kansas.....	1.7	11.6	2.5	78.6	5.6
1	Kentucky.....	1.6	10.6	2.4	79.6	5.8
3	Massachusetts..	1.7	11.6	2.4	79.5	4.8
8	Michigan	1.6	12.6	2.6	77.7	5.5
2	Minnesota	1.9	11.0	1.9	80.5	4.9
5	Mississippi	1.6	11.1	2.0	79.5	5.8
22	Missouri	1.9	11.4	2.6	78.2	5.9
1	New York.....	1.7	9.9	2.6	80.8	5.0
1	North Carolina	1.5	11.8	1.6	79.6	5.5
4	Pennsylvania ..	1.5	9.4	2.1	81.3	5.7

1 South Carolina	1.5	13.8	2.3	77.4	5.0
19 Texas	1.6	11.6	3.1	77.6	6.1
Average of all.....	1.7	11.5	2.3	79.1	5.4
Av'ge, 35 Northern	1.7	11.8	2.3	79.1	5.1
Av'ge, 49 Southern	1.7	11.5	2.3	78.7	5.7

With so little difference in the analyses of different types from different localities, color evidently has but little effect.

No experiments have been made to determine the relative digestibility of the differently colored corns, but as their analyses are so nearly the same it is highly improbable that their color alone would in any way affect their digestibility, and consequent feeding values.

SELECTION OF SEED.

Corn is a plant which is quite variable, even among the plants which may have been grown from a single ear. This is partly due to its natural tendency to variation, and, to a still greater degree, to the fact that every ear has usually been fertilized by pollen from many different stalks, so that it may give crosses between the plant on which it is borne and a hundred or more of those which surround it. A fertile or a barren soil has a temporary effect on the size of the stalk and the number of ears, but this influence does not appear to be lasting in its effects. The length of the growing season has a marked effect on the time required for the maturity of the crop in any given locality. In the tropics, where frost is unknown, the crop takes 150 to 200 days for maturing, while several varieties which have been grown in the extreme North for many generations will mature fully in from 70 to 80 days. In the "corn belt" from Indiana to Nebraska, the usual time required for maturity is about 125 days, while in Mississippi our best yields have been from varieties which required 140 to 170 days for their full maturity.

The saying that "like produces like" is just as true of corn as of other things. For ordinary purposes in Mississippi we have no occasion to select our seed from the early maturing stalks, but need only to select from those stalks which are nearest our ideal of the type we consider the best. The value of any variety depends nearly or quite as much on the growth of the stalk as upon the size and shape of the individual ears, and therefore seed should always be selected in the field rather than in the crib. We cannot expect a

good crop without strong and vigorous stalks, and we can judge of the stalks only as we see them in the field. The best plan for the selection of seed is to go through the field before the crop is harvested, and select the best ears from the best stalks, though if careful hands are engaged in the harvesting nearly as good a selection may be made by having a box in the wagon while gathering the crop, and throwing the selected ears into this box. As stated before, we have secured the best yields from varieties which have averaged nearly two ears to the stalk, and in selecting ears for seed we take them only from stalks having two good ears each. We take only ears which are well formed, above the average in size and of nearly equal diameter throughout, well filled at both ends, the length of the kernels being fully two-thirds the diameter of the cob, and the kernels broad at the top so as to leave but little space between the rows. If a stalk has two good ears, we take both; if one ear is unusually good and the other of fair size and shape, we take only the better one, while if the second ear be poor we reject both. It is fully as important to select ears from the best stalks as it is to have the best ears, and by this plan we secure both, and so work a gradual, constant, improvement in the variety. In selecting seed from the crib, as is often done, nothing can be known of the character of the stalks upon which it was grown, and such a selection will do but little to improve a variety.

After selecting the seed we sun it until thoroughly dry, and then nail it in mouse-proof boxes, leaving it on the cob and putting a little bisulphide of carbon in the boxes to kill weevils.

It is a common practice to remove the tips and butts of the ears when shelling for planting, but we have not been able to find any benefit from the practice, and the results of work at other stations where tips, middles, and butts have been planted separately do not show that the seed from any one part of the ear has any advantage over that from any other part.

COLOR AND YIELD.

Whether yield is any way affected by color, and whether white or yellow varieties produce the greater yield, has always been a matter of dispute, about which opinions have been quite evenly divided. In order to gain definite information in regard to this, this station has made

138 tests with 45 varieties of dent corn, the number including nearly all those of each color which been advertised by the leading seedsmen from 1889 to 1893, and a large number of local varieties which are grown in this state. As a result of this work the 75 tests with 25 white varieties have given an average yield of 43 bushels per acre, while the 63 tests with 20 yellow varieties have given an average of only 38.2 bushels per acre. These total averages coincide very closely with the partial results published in several of our Annual Reports, and which were as follows: In 1890 the yield of 17 white varieties was 44.6 bushels per acre, while 15 yellow varieties gave 37.1 bushels. In 1891, 25 white varieties yielded 37.5 bushels, while 18 yellow varieties yielded 34.9 bushels per acre. In 1892 the yield of 11 white varieties was 45.2 bushels, while the same number of yellow varieties gave only 40-5 bushels per acre. In 1893 and 1894 the tests were continued with 22 white varieties yielding 42.7 bushels, and 19 yellow varieties yielding 39.1 bushels per acre. During each year of this work the two varieties giving the heaviest yields were both white, though not always the same varieties.

These results have been so uniform, and have indicated so strongly that the better yield can usually be secured from the white varieties, that the published records of similar work done at other stations have been examined very carefully, and have been found to correspond very closely with the results secured at this station. While a considerable number of stations have made a few tests of varieties, the more reliable figures will be secured by considering only the work of such stations as have made the greater number of tests, and which have continued the tests through several years. In the preparation of the following summary the "flint" and "flour" varieties have been excluded as having no interest for Mississppi corn growers; and the records of varieties of which the color is not given, or which have made yields of less than twenty bushels per acre have been omitted. The exclusion of these varieties makes the figures from the several stations vary slightly from those given in the different reports, but does not change the final result.

With that basis, we find the results of the work of the seven stations which have made more than fifty tests each, to be as follows:

ARKANSAS.—Twenty-eight varieties, fifty-eight tests:
Average yield of 14 white varieties, 36.7 bushels per acre.
Average yield of 14 yellow varieties, 36.6 bushels per acre.
Average yield of white varieties tested 2 or more times, 38.2 bushels.
Average yield of yellow varieties tested 2 or more times, 33.6 bushels.

		bushels per acre
Best yields—	Normandy, white	70.0
	Mosby, white	58.3
	Leaming, yellow	55.8
	Piasa King, white	55.3
	Piasa Queen, yellow	55.3

ILLINOIS.—One hundred fifty-five varieties, four hundred sixty-seven tests:
Average yield of 54 white varieties, 63.1 bushels per acre.
Average yield of 101 yellow varieties, 62.0 bushels per acre.
Average yield of white varieties tested 2 or more times, 60.9 bushels.
Average yield of yellow varieties tested 2 or more times, 57.2 bushels.

		Bushels per acre
Best yields—	Gourdseed, white	111.6
	Menhall, yellow	111.3
	Dresback, white	104.2
	Helms, white	102.6
	Burr, white	101.7

INDIANA.—Forty-four varieties, eighty-one tests.
Average yield of 16 white varietiess, 54.8 bushels per acre.
Average yield of 28 yellow varieties, 56.3 bushels per acre.
Average yield of all white varieties tested 2 or more times, 52.5
Average yield of all yellow varieties, tested 2 or more times, 58.0

		Bushels per acre
Best yields—	Tennessee, yellow	88.1
	Ivory Dent, white	86.2
	Southern Red Cob, white	79.0
	White Prolific, white	76.8
	Piasa Queen, yellow	74.5

KANSAS.—One hundred twenty varieties, one hundred eighty-six tests.

Average yield of 53 white varieties, 54.2 bushels per acre.

Average yield of 67 yellow varieties 53.1 bushels per acre.

Average yield of all white varieties tested 2 or more times 56.7

Average yield of all yellow varieties tested 2 or more times 53.5

		bushels per acre
Best yields—	Normandy, white	116.0
	Mosby, white	101.0
	St. Charles, white	98.0
	Naylor, white	96.0
	Mammoth Dent, white	91.6

LOUSIANA.—Thirty-nine varieties, one hundred eighty-six tests. (Combined results from three stations.)

Average yield of 30 white varieties, 47.5 bushels per acre.

Average yield of 9 yellow varieties, 39.7 bushels per acre.

Average yield of all white varieties tested 2 or more times, 48.8.

Average yield of all yellow varieties tested 2 or more times, 38.7.

		Bushels per acre.
Best yields—	Patterson, white	109.5
	Mosby, white	103.7
	Conscience, white	101.5
	Kansas King, white	98.0
	Stowe, white	94.5

MISSISSIPPI.—Forty-five varieties, one hundred thirty-eight tests:

Average yield of 25 white varieties, 43.0 bushels per acre.

Average yield of 20 yellow varieties, 38.7 bushels per acre.

Average yield of all white varieties tested 2 or more times, 42.5 bushels.

Average yield of all yellow varieties tested 2 or more times, 38.9 bushels.

		Bushels per acre.
Best Yields—	Mosby, white	74.5
	Price, white	70.2
	Golden Dent, Yellow	69.0
	St. Charles, White	66.2
	Eclipse, yellow	56.7

OHIO.—Fifty-nine varieties, one hundred forty-one tests:
Average yield of 25 white varieties, 55.4 bushels per acre.
Average yield of 34 yellow varieties, 51.3 bushels per acre.
Average yield of all white varieties tested 2 or more times, 57.0 bushels.
Average yield of all yellow varieties tested 2 or more times, 53.2 bushels.

		Bushels per acre.
Best yields—	Parrish, white	92.7
	Clarage, yellow	87.6
	Leaming, yellow	85.7
	Chester Co., yellow	81.0
	Arleus, yellow	80.3

A recapitulation of these data gives the following:

	WHITE.		YELLOW.		EXCESS.	
	No. of varieties.	Yield per acre.	No. of varieties.	Yield per acre.	White.	Yellow.
Arkansas	14	36.7	14	36.6	.1	
Illinois	54	63.1	101	62.0	1.1	
Indiana	16	54.8	28	56.3		1.5
Kansas	53	54.2	67	53.1	1.1	
Louisiana	30	47.5	9	39.7	7.8	
Mississippi	25	43.0	20	38.7	4.3	
Ohio	25	55.4	34	51.3	4.1	
Total	217		273			
Average		50.7		48.2	2.5	

These figures show that in a total of 1267 tests with 490 varieties, the average yield of 217 white varieties has been 2.5 bushels per acre in excess of the yield of 273 yellow varieties; and that at only one of the seven stations making these tests have the yellow varieties given the better average yield. At six of the seven stations some one white variety has given the best yield, and of the thirty-five varieties named as giving the best yields at the different stations, twenty-four are white and only eleven are yellow. If only the varieties which have been tested two or more times at each station are considered, the average yield of the white varieties has been 50.9 bushels per acre, against 47.6 bushels for the yellow varieties.

Such an agreement in results over such a wide area, and secured by such a large number of careful tests, cannot be accidental, but shows very plainly that it is usually possi-

ble to secure greater yields from white than from yellow varieties. These results do not indicate that any one white variety will always outyield any yellow variety under all circumstances, but they do indicate that of all the varieties adapted to a given locality, some one or more of the white varieties will usually give a larger yield than will any of the yellow varieties.

While we cannot explain the reason for this, we cannot doubt it, and it is interesting to note the fact that the rule that white varieties outyield colored varieties holds equally true of other grains as well as of corn. In connection with the tabulation of the records of corn yields at the different stations a careful examination was made of the reported yields of wheat and oats, and, without going into details, it may be stated that in both the white varieties have given decidedly the heavier yields.

WHAT CONSTITUTES A DESIRABLE VARIETY.

In Mississippi, where hay can be made with so little trouble and expense, the only practical value of a crop of corn is in the amount of shelled grain that may be produced. The fodder which may be pulled has a certain value, and the stalks may be used in the place of hay, but here both are expensive substitutes of doubtful economy for which we cannot afford to sacrifice any part of the grain yield. In a climate like this, where we have at least six months without frost, the large growing and late maturing dent varieties will produce much heavier yields than will the early maturing flint varieties which are grown so largely in the North. As has been shown, the feeding values of different varieties vary but little, a pound of the shelled grain of any variety having very nearly the same feeding value as an equal amount from any other variety, and therefore the only point which needs to be considered by the Mississippi planter is, which variety will give the greatest amount of shelled grain per acre. Under ordinary circumstances, earliness of maturity need not be considered, and there is little difference among varieties in their power to resist attacks from insects.

Varieties giving nearly the same yields may differ sufficiently in their rooting habits to make some much more desirable than others. Strong and well spread roots are necessary to hold the stalk erect after it reaches maturity, or there will be a considerable loss from the decay of ears

on stalks which have fallen or been blown down. A weakness of the root system is very commonly found among the unusually prolific varieties like "Blount's Prolific," while the stronger rooting sorts like "Evans" do not usually produce so large a yield. If the crop is to be gathered as soon as ripe, as it should be, a strong root system is less essential, as most of the loss from blowing down occurs late in the season; but when the corn is to remain in the field for any length of time after ripening it should be on a stalk which is not liable to fall over.

Another point which affects the relative values of varieties is the direction assumed by the ear in ripening. If the ripened ear points upward, rain will find its way between the loosened husks at the top and will often be held for some time by the closer husks at the butt, when a few warm days will cause the wet corn at the butt of the ear to sprout or to rot. If the top end of the ear hangs downward in ripening rain will be shed, and so will cause no loss. These two points should each receive attention in the selection of a variety.

Whether the stalk should have one ear or several, is a point which is much disputed, and with it goes the old question of whether the cob should be large or small. Ordinarily when a variety produces only one ear to a stalk, that ear will be larger than the ears of those varieties producing two or more ears. If the one large ear has as much corn as the two or more smaller ones, it is better, because it can be gathered and handled more easily, but eleven ounces of grain on two ears from one stalk is worth more than ten ounces from a stalk bearing only a single ear, as the same number of stalks of each can be grown on an acre. Among the many varieties which have been tested at the station those which produce usually only one ear to the stalk have given smaller yields than those which have produced a greater number of ears. It is quite possible however to increase the number of the ears at the expense of the total yield of grain. Three years ago a correspondent sent us a stalk bearing seven ears, and an accompanying letter offered a supply of the seed for twelve dollars a bushel. A workman was sent to one of the station fields with orders to bring the first five stalks he could find, each of which had two ears. Both lots were dried thoroughly before shelling, and in every case the grain from the stalks bearing two ears outweighed that from the seven eared

stalk. We have found no variety which produces uniformly one, two, or any other number of ears, but have found the ears to vary from 86 to 537 on one hundred stalks, counted as they stood in the rows. The best yields have come from those varieties which produce from 175 to 200 ears to one hundred stalks, and we have endeavored to find or to produce a variety which should have uniformly two ears on each stalk, as the nearer we have been able to approach such a variety, the greater has been the yield of grain per acre.

The common argument in favor of a large cob is that "a large cob will hold more than will a small one." That is very true, but it is not true that seventy pounds of ears having large cobs will produce as much shelled corn as will the same weight of ears having small cobs. The length of the grains has very little relation to the size of the cobs, for we find large cobs with short grains and small cobs with long grains, and *vice versa*. If the grains are half an inch in length, and the cob half an inch in diameter, the grain will fill seven-eighths of the space occupied by the ear; while if the grains be of the same length and the cob an inch in diameter, the grain will occupy only three-fourths of the space—a difference of about one-eighth in favor of the smaller cob. As small ears will pack more closely than will large ears the grain contained in a measured bushel or barrel is still more in favor of the smaller size. These statements have been verified by many repeated weighing and measurings which have shown a difference of more than one hundred per centin the amounts of cob in a bushel (70 pounds) of different varieties. In the "Mosby" seventy pounds of ears contains about sixty-three pounds of grain and seven pounds of cobs, while in the "Parrish White Dent," a variety having practically the same length of grain, we have only fifty-three pounds of grain with seventeen pounds of cob. It is true that these two varieties are extreme cases, but instances of from six to eight pounds variation have been very common. Seventy pounds of ears is a legal bushel in nearly all parts of the country, and corn is largely bought and sold on that basis, though the only valuable part of the seventy pounds, the grain, may vary nearly twenty per cent. As 56 pounds is the legal weight of a bushel of shelled corn this point is one which should receive attention in either buying or selling. The smaller cob dries out more quickly than does the larger one, and so is less liable to injury or decay when it

has been wet. A large cob is usually quite soft, and is often actually open at the butt, giving free entrance to rain and holding water like a cup, and injury from becoming water-soaked is much more common than when the cob is small.

If an acre will produce only a certain number of ears, the larger the ears the greater will be the yield of grain; but as a matter of experience we find that a marked increase in the size of the ears is accompanied by an almost corresponding decrease in their number, and we have found no single-eared variety which will produce ears containing as much grain as will the two medium sized ears which we can secure as the average per stalk of several well known varieties. We have found it more profitable to use a variety having ears of a medium size, and then to increase the number of such ears on each stalk, rather than to increase their size.

To sum up the characteristics of the variety which, from the tests which have been made at this Station seems the most desirable for Mississippi, it is shown that should be:

A "dent" rather than a "flint" variety.

That the ears should point downward and not upward when mature.

That the stalk should have well developed roots.

That the stalks should average nearly or quite two ears each.

That the ears should be of medium size.

That the individual grains should be long.

That the cob should be small.

That the grain should be white.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 34.

MISSISSIPPI FUNGI.

S. M. TRACY AND F. S. EARLE.

AGRICULTURAL COLLEGE, MISS.,

MAY, 1895.

The bulletins of the Station are sent free of charge to all farmers in Mississippi who apply for them.

MISSISSIPPI FUNGI.

The following list of fungi which have been found in Mississippi is but little more than a record of the collections which have been made by the authors at such odd times as could be spared from other and more imperative duties, but as the material in hand has recently been studied somewhat carefully, it seems desirable that the work so far accomplished should be put on record in some permanent form in which it may be available for the use of other workers in the same field. It will be seen that a few families are quite largely represented, while others have received no notice, which perhaps is not surprising in a list made from the material of only two collectors who have been specially interested in certain groups, and who have been able to give but very little attention to others such as the Gasteromycetes, Hymenomycetes, and Myxomycetes.

We believe that this is almost the first work of the kind which has been done in the state, and that Mississippi is an unworked field is shown in the fact that of the entire 353 species which have been collected, no less than 55, or nearly one-sixth, have proved to be new. Copies of the original descriptions of the new species have been collected, and are republished here.

A recapitulation of the list shows the distribution of the species to be as follows:

FAMILY.	Genera.	Species.
Uredineae	16	103
Ustilagineae	5	19
Peronosporeae	3	12
Chytridiaceae	1	3
Erysipheae	6	21
Perisporeae	9	21
Sphaeriaceae	10	13
Hypocreaceae	3	3
Dothidiaceae	4	7
Hysteriaceae	3	6
Discomycetes	8	11
Fungi Imperfecti	45	134
Total	113	353

In the arrangement of the list, and in the nomenclature of the fungi, we have followed Saccardo's "Sylloge Fungorum;" and in the naming of the host plants have used the names given in "Chapman's Flora." While we appreciate the fact that many of the names given in Chapman are obsolete, it seemed better to use an authority which is generally accessible than to attempt any fragmentary revision, or to use a list which covers only a small proportion of our southern flora. Thanks are due to Mr. J. B. Ellis, Dr. C. H. Peck and Mr. B. T. Galloway for the determination of doubtful species.

All of the fungi named in the list are now in the herbaria of the authors, and only two species are named which have not been collected by them.

UROMYCES Lk.

U. affinis Wint.

On Hypoxis erecta, Biloxi.

U. Andropogonis Tracy.

On Andropogon Virginicus, Ocean Springs and Starkville. This has the same general appearance of Puccinia Andropogonis Schw., but is much less common. Described in Jour. Mycol., Vol. VII, No. 3, p 281, as follows:

"(II,III). Hypophyllous. Sori oval or oblong, sometimes confluent; uredospores light colored, sub-globose, sharply echinulate, 16–17 by 16–19μ; teleutospores dark brown, broadly oval, apex obtuse, rounded, strongly thickened, 14–16 by 24–28μ; pedicel somewhat tinted, twice the length of the spore."

U. appendiculatus (Pers) Lk.

On leaves of beans. Seldom seen during the early summer, but often very injurious to late grown black-wax and Lima varieties.

U. Caladii (Schw.) Farl.

On Arisaema dracontium, Starkville.

U. Dactylidis Otth.

On Festuca tenella, Starkville. In 1890 a quantity of this grass was grown from seed imported from France, and on this the Uromyces was very abundant, while none was found on the same species from adjoining plots which had been planted with home-grown seed, and the fungus has not since been observed.

U. Eragrostidis Tracy.

On Eragrostis pectinacea, Starkville. The uredo form is quite common, especially on plants growing in rather dry and sterile soil, but the teleutospores are rare, being found only on occasional plants late in the season. Described in Jour. Mycol., Vol. VII, No. 3, p 281, as follows:

"(II, III). Amphigenous. Sori minute, scattered, long covered by the epidermis; uredospores light yellow, subglobose, echinulate, 16–18 by 17–20μ; teleutospores usually oval or obovate, often angular, epispore smooth, thickened at the apex, 14–16 by 22–28μ; pedicel slightly tinted, as long as the spore."

U. Euphorbiae C. & P.

On Euphorbia prostrata, Deer Island; E. humistrata and E. polygonifolia, Ocean Springs; E. maculata and E. nutans, Starkville. Common throughout the state on species of Euphorbia.

U. graminicola Burrill.

On Panicum virgatum, Ocean Springs; Andropogon macrourus, Starkville.

U. Hedysari-paniculata (Schw.) Farl.

On various species of Desmodium in all parts of the state.

U. Hyperici (Schw.) Curt.

On Hypericum mutilum, Lake and Meridian.

U. Lespedezae (Schw.) Pk.

On Lespedeza capitata, L. repens and L. violacea, Starkville. Found on nearly every plant of all the native species of Lespedeza, but not observed on the introduced L. striata, with one possible exception, when plants of that species were found at Starkville bearing some undetermined uredospores.

U. Limonii (DC.) Lev.

On Statice Caroliniana, Pointe du Chene, Jackson county. I and III. The bright red spots and the large yellow clusters of the aecidium give the affected plants a very distinct and striking appearance.

U. Panici Tracy.

On Panicum anceps, Martin, (J. M. White.) This is quite distinct from U. graminicola Burrill, and is described in Jour. Mycol., Vol. VII, No. 3, p 281, as follows:

"Hypophyllous. Sori oval or oblong, sometimes becoming confluent; uredospores light yellow, faintly echinulate, globose, 12-16μ; teleutospores dark brown, oval, smooth, apex thickened and somewhat beak-like, 14-16 by 26-30μ; pedicel tapering, tinted, somewhat longer than the spore."

U. Polygoni (Pers.) Fckl.

On Polygonum acre, Jackson and Starkville; P. aviculare, Ocean Springs and Starkville; P. hydropiperoides, Saltillo; and on undetermined species in nearly all parts of the state.

U. Spermacoces (Schw.) Thum.

On Diodia teres, Crystal Springs, Ocean Springs, and Starkville.

U. striatus Schroet.

On Trifolium Carolinianum, Starkville, I, II, and III.

U. Terebinthi (DC.) Wint.

On Rhus radicans, Starkville and West Point.

U. **Trifolii** (Hedw.) Lev.

On Trifolium Carolinium, T. pratense, and T. procumbens, Starkville. Occasionally so abundant as to seriously injure large patches of T. pratense.

MELAMPSORA Cast.

M. farinosa (Pers.) Schroet.

On Salix longifolia and S. nigra, Starkville.

M. Populina (Jacq.) Lev.

On Populus monolifera, Starkville.

M. Quercus (Brond.) Schroet.

On several species of Quercus, in all parts of the state.

CRONARTIUM.

C. Asclepiadeum (Willd.) Fr. var **Quercum** Cke.

On several species of Quercus; quite common in the northern and central parts of the state.

PUCCINIA Pers.

P. Aletridis B. & C.

On Aletris farinosa, Ocean Springs. Seemingly quite local.

P. Andropogonis Schw.

On species of Andropogon in all parts of the state, but nowhere very abundant. Affected plants are usually very seriously infested, while other plants only a few inches distant may be entirely healthy. A Puccinia which it is impossible to distinguish from this species has been found on Bromus madritensis at Starkville.

A. angustata Pk.

On Carex riparia, Starkville.

P. Anthoxanthi Fckl.

On Anthoxanthum puelli, Starkville. Like Uromyces Dactylidis, this has been found only on plants grown from seed imported from France.

P. Asteris DBy.

On various Compositæ in all parts of the state.

P. Caricis (Schum.) Reb.

On Carex retroflexa, Ocean Springs and Biloxi.

P. Cladii Ell. & Tracy.

On Cladium effusum, Ocean Springs. Described in Bul. Torr. Club, Vol. 22, No. 2, as follows:

"On the culms and peduncles of the cyme. Sori small, elliptical, subconfluent, so as often to envelope and cover the peduncles for 2 or more cm. in extent; at first covered, then bordered by the ruptured yellowish epidermis. Uredospores ovate or elliptical, 22-25 by 20μ or subglobose, 18-20μ, at first hyaline, then deep red-brown (or ferruginous-yellow while lying in the sori) aculeate. Teleutospores in similar but much darker colored sori, clavate or oblong, 45-60 by 18-20μ, constricted, deep brown, lower cell narrower and paler, epispore smooth or slightly granular-roughened above, strongly thickened at the obtusely rounded apex, or with an oblique papilla, or sometimes sub-truncate-flattened. Pedicels shorter than the spores, hyaline or slightly colored, stout. The uredospores are also pedicellate."

P. Conoclinii Seymour.

On Conoclinium coelestinum, Jackson and Starkville. Common.

P. coronata Corda.

On Avena sativa, Ocean Springs and Starkville; Holcus lanatus, Starkville. This Puccinia affects Holcus quite seriously, many plants becoming so covered with uredosori that they die before reaching maturity.

P. **Dichondræ** Mont.

On Dichondra repens, Jackson. Abundant in that one locality, but not observed elsewhere.

P. **emaculata** Schw.

On Panicum capillare, Starkville; P. virgatum, Ocean Springs and Starkville; Tricuspis seslerioides, Jackson and Starkville. This is very common on Tricuspis in the central part of the state, nearly every plant being affected. We have a single specimen of what appears to be this species on Panicum anceps, from Starkville, though it differs somewhat from the usual form, being epiphyllous only, spots bright red and distinct, sori elliptical, rarely confluent, not occurring on the sheaths.

P. **fusca** Rebh.

On Anemone Canadensis and A. Virginiana, Starkville.

P. **Galiorum** Lk.

On Galium triflorum, Grenada. Although several species of Galium are common in all parts of the state, the Puccinia has been observed in only one locality.

P. **Gonolobi** Rav.

On Gonolobus hirsutus, Starkville; Suetera maritima, from islands along Mississippi Sound.

P. **graminis** Pers.

On many grasses, but apparently less common than P. rubigo-vera.

P. **Helianthi** Schw.

On Helianthus annuus and H. tuberosus, Starkville.

P. **heterospora** B. & C.

On Sida spinosa, Jackson and Starkville. Quite common.

P. Hieracii (Schum.) Mart.

Common on many Compositae in all parts of the state.

P. Hyptidis (Curtis) Tracy & Earle.

On Hyptis radiata, Biloxi. This has been carefully compared with the descriptions of Uredo Hyptidis Curtis, in Am. Jour. Sci., Vol. II, No. 6, published in 1820; and of P. Gilbertii Speg. in Fung. Arg., II, No. 14, published in 1880-82; and is so evidently the same species as that referred to in those publications, that we write the name as above.

P. lateripes B. & R.

On Ruellia ciliosa, Biloxi.

P. Menthæ Pers.

On Monarda fistulosa, Starkville.

P. microsperma B. & C.

On Lobelia spicata, Starkville. Quite rare.

P. nigrovelata Ell. & Tracy.

On Cyperus strigosus, Starkville and Gibson. Described in Bul. Torr. Club, Vol. 22, No. 2, as follows:

"Uredospores in short (1-2 mn), oblong-elliptical sori, surrounded by the erect margin of the ruptured epidermis, ovate or elliptical, pale yellowish, aculeolate, 15-24μ (mostly 15-20μ by 12-15μ), mass of spores cinnamon colored. Teleutospores in flat sori, 1-3 mm. long $\frac{3}{4}$—1 mm. broad, closely covered by the epidermis, which appears black by translucence, clavate-oblong, 35-55 by 14-18μ, broadly constricted, lower cell pale and narrowed to the pedicel, upper cell broader and darker, epispore smooth, thickened at the apex; which is either rounded or obtusely pointed, with or without a hyaline papilla. Pedicels mostly shorter than the spores. The teleutospore sori at length open by a longitudinal crack along the middle." The uredo form is quite common, but usually so thoroughly parasitised by Darluca filum that teleutospores are seldom formed.

P. Podophylli Schw.

On Podophyllum peltatum, Starkville. Quite common.

P. Polygoni Pers.

On Polygonum Pennsylvanicum, Starkville. Not Common.

P. Pruni Pers.

On Prunus Americana, P. angustifolia, P. Armeniaca, P. Japonica, P. mume, P. Persica and P. Simonii. Very injurious to all species of Prunus in the southern part of the state, but further north it is confined principally to P. Americana and P. angustifolia.

P. rubigo-vera (DC.) Wint.

The most common species on grains and grasses.

P. Saniculæ Grev.

On Sanicula Canadensis, Starkville.

P. Smilacis Schw.

On several species of Smilax. Common everywhere.

P. Sorghi Schw.

On Zea Mays, Madison Station and New Albany. Quite rare.

P. Spegazzini DeT.

On Mikania scandens, Ocean Springs.

P. **Sporoboli** Arth.

On Sporobolus asper, Holly Springs and Starkville. Very common,

P. **Taneceti** DC.

On Helianthus annuus, Starkville.

P. **vexans** Farl.

On Boutelous curtipendula, Starkville.

P. **Xanthi** Schw.

On Xanthium strumarium, Gibson, Holly Springs and Starkville.

UROPYXIS Schroet.

U. Amorphae (Curt.) Schroet.

On Amorpha fruticosa, Ocean Springs and Pointe du Chene.

GYMNOSPORANGIUM Hedw.

G. bermudianum (Farl) Earle.

On Juniperus Virginiana, Biloxi and Ocean Springs. This species was distributed by Seymour & Earle in "Economic Fungi" and is described as follows: "I. Agcidial stage: A true Rœstelia, developing in the fall on small

globose or somewhat irregular galls or distortions on leaves or small twigs (of Juniperus Virginiana). Peridium long exserted, fragile; margin laciniate or fimbriate, not recurved; cells broadly oval, easily separable, cell-wall conspicuously ribbed. Spores small, 17.5 to 19.5 by 19.5 to 27μ, globose or polygonal, apparently smooth.

See also Farl. Bot. Gaz. 12: 206 d; S. 1887.

III. Teleutosporic stage following the Accidial stage on the same galls in spring. Sporiferous masses usually few, short and inconspicuous. Spores 2-celled, irregularly orbicular, oval, oblong, or double-conical, resembling those of G. macropus, 18.5 to 29 by 29 to 55μ. Promycelium and sporidia unknown."

As far as is at present known, this is the only instance in which both the aecidial and teleutosporic forms of a Gymnosporangium occur on the same host.

G. clavipes C. & P.
On Juniperus Virginiana, Starkville.

G. globosum Farl.
On Juniperus Virginiana, Starkville.

G. macropus Lk.
On Juniperus Virginiana, Biloxi and Starkville.

G. nidus-avis Farl.
On Juniperus Virginiana, Starkville. Collected only once. G. clavipes, globosum, and macropus are quite common in the central part of the state, the three species being often found on the same tree.

PHRAGMIDIUM Lk.

P. **Fragariastri** (DC) Schroet.
On Fragaria indica, Jackson, Starkville and Vicksburg.

P. **Potentillae** (Pers) Karst.
On Potentilla Canadensis; Jackson, Starkville, and Vicksburg.

P. **speciosum** Fr.
On Rosa lucida, Saltillo, R. blanda, Starkville.

P. **subcorticium** (Schrank) Wint.
On Rosa Carolina, Holly Springs.

COLEOSPORIUM Lev.

C. Ipomeæ (Schw) Burrill.
On Ipomea batatas, Ocean Springs; I. pandurata, Starkville.

C. Sonchi (Pers) Lev.
On Elephantopus Carolinianus, Durant, Martin, Starkville, Biloxi; Silphium integrifolium, Starkville; Solidago pauciflosculosa, Pointe du Chene; Vernonia fasciculata, Starkville.

CHRYSOMYXA Unger.

C. albida Kuhn.
On Rubus villosus, Harmon Lake, Oktibbeha county.

PUCCINIASTRUM Otth.

P. **crotonis** (Burrill) DeT.
On Croton capitatus, Durant, Starkville; C. monothgyneum, Starkville.

RAVENELIA Berk.

R. Cassiæcola Atks.
On Cassia nictitans, Martin (J. M. White) and Starkville.

AECIDIUM Pers.

A. Compositarum Mart.
On various Compositæ in all parts of the state.

A. Diodæ Burrill.
On Diodia teres, Crystal Springs, Ocean Springs and Starkville.

A. Dracontium Schw.
On Arisæma dracontium, Starkville.

A. Epilobii DC.
On Œnothera fruticosa, Starkville.

A. Euporbiae Gmel.
On Euphorbia Preslii, Starkville; E. prostrata, Ocean Springs.

A. Fraxini Schw.
On Fraxinus Americana, Starkville. Quite rare, but collected in 1891 and 1892.

A. Grossularieæ Schum.
On Ribes uva-crispa, Starkville.

A. Hypericatum Schw.
On Ascyrum Crux-Andræ, Lake, and Harrison county.

A. Ludwigeæ E. & E.
On Ludwigia hirtella, Biloxi and Ocean Springs.

A. Marie-Wilsoni Pk.
On Viola cucullata, Starkville; V. palmata, Ocean Springs.

A. Oldenlandianum Ell. & Tracy.
On Houstonia purpurea, Starkville. Described in Jour. Mycol., Vol. VII, No. 1, as follows:

"Hypophyllous; aecidia few in a cluster, 80-100μ in length, the mouth but little split and not recurved; spores globose or sometimes slightly angled; epispore thin, smooth, bright yellow; 14-16μ. On Houstonia cærulea, Starkville, Miss., April, 1888. Although the name 'Oldenlandia' is obsolete as applied to this host, the name is given to this Aecidium on account of the name 'Houstonianum' being already occupied by the Æcidium Houstonianum, Schw., from which this differs in the longer, narrower aecidia, smooth spores, and spermagonia rare or wanting."

A. Pentastemonis Schw.
On Pentstemon pubescens, Starkville.

A. Plantaginis Ces.
On Plantago Virginica, Starkville.

A. Podophylli Schw.
On Podophyllum peltatum, Starkville. Often parasitized by Macrosporium Podophylli.

A. Polemonii Pk.
On Phlox paniculata, Starkville.

A. Rhamni Gmel.
On Berchemia volubilis, Starkville.

A. Ranunculacearum DC.
On Ranunculus fascicularis, Starkville.

A. Ranunculi Schw.
On Ranunculus abortivus, Starkville.

A. Smilacis Schw.
On Smilax tamnifolia, Starkville.

A. Statice Desm.
On Statice Caroliniana, Pointe du Chene.

RŒSTELIA Rebent.

R. auriantiaca Pk.
On Cratægus coccinea, Starkville.

R. lacera Fr.
On Cratægus coccinea and C. crus-galli, Starkville.

R. Pirata Schw.
On Cydonia Japonica and Pirus malus, Crystal Springs and Starkville. This is frequently quite injurious to the quince, as it is commonly found upon the fruit.

PERIDERMIUM Lev.

P. orientale Cke.
On Pinus rigida and P. Virginiana, Starkville.

UREDO Lev.

U. Fici Cast.
On Ficus carica. Common, but seldom doing serious injury.

U. Nyssæ Ell. & Tracy.
On Nyssa aquatica, Ocean Springs; N. capitata, Jackson. Described in Jour. Mycol. Vol. VI, No. 2, as follows:
"Hypophyllous, sori minute and scattered over the entire under surface of the leaf, but not confluent; spores globose to pyriform, epispore thin, minutely chinulate, 12-15 by 15-30μ."

U. peridermiospora Ell. & Tracy.
On Spartina glabra, Ocean Springs. Described in Jour. Mycol., Vol. VI, No. 2, as follows:
"Epiphyllous, sori linear, near the base of the leaf, long covered by the remains of the ruptured epidermis; spores bright red, pyriform, echinulate, much thickened at the apex. 19-22 by 36-45μ; pedicel short but distinct."

CÆOMA Tul. (Subgenus of Uredo. Sacc.)

C. Agrimonieæ Schw.
On Agrimonia Eupatoria, Grenada.

C. nitens Schw.
On Rubus villosus. Very common everywhere.

USTILAGINEÆ Tul.

USTILAGO Pers.

U. diplospora E. & E.

On Panicum sanguinale, Holly Springs, Saltillo and Starkville. Very distinct from other species of Ustilago on the same host, and described in Jour. Mycol., Vol. VI, No. 3, as follows:

"In ovaries of Panicum sanguinale. Mass of spores dark brown. Spores of two kinds, the smaller ones globose, rough, brown, 7-8μ diameter; the larger ones 12-15μ. smooth, globose, pale, nearly hyaline."

U. Maydis (DC.) Corda.

On Zea Mays. Common.

U. ornata Tracy & Earle.

On Leptochloa mucronata, Starkville. Described in Bul. Torr. Club, Vol. 22, No. 4. as follows:

"Infesting the ovaries; spore masses black, pulverulent, 20-30 mm. in diameter; spores subglobose, very thickly beset with strong and prominent echinulations which give the spore a burr-like appearance, 12-12 by 15μ; Panicles bearing affected ovaries always remain partially enclosed within the sheath of the upper leaf."

U. Oxalidis E. & T.

On Oxalis stricta, Starkville, and probably widely distributed, but as it is quite inconspicuous it has not been colelcted elsewhere in this state. Described in Jour. Mycol., Vol. VI, No. 2, as follows:

"In ovaries of Oxalis stricta, filling the entire ovary with a mass of reddish brown spores; spores globose. 10-12μ; epispore rather thick, sharply echinulate."

U. pustulata Tracy & Earle.

On Panicum proliferum, Starkville. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:

"Infesting the ovaries, or forming rounded, bullate swellings which often surround the entire stem and branches of the panicle, or form irregular distortions on the leaves and sheaths; spore masses dark brown, long covered by a stramineous membrane which is a distortion of the host, 25-75 mm. in diameter; spores dark brown or fuscous, sub-globose or oval, cell wall very thin, slightly echinulate. 7-5 to 9 or 7 by 9μ."

U. Rabenhorstiana Kuhn.
On Panicum sanguinale, Starkville. Very common in late summer.

U. segetum (Bull.) Dit.
On Arrhenatherum Avenaceum and Avena sativa, Starkville; Triplasis Americana, Deer Island.

U. spermaphora B. & C.
On Eragrostis major, Starkville.

U. Uniolæ E. & E.
On Uniola gracilis, Biloxi. Found in one locality only, in a strip of ground not more than ten yards wide and sixty rods long just outside the edge of thick woods where it is shaded from the afternoon sun.

U. utriculosa (Nees) Tul.
On Polygonum aviculare var. erectum, Starkville; P. Pennsylvanicum, Saltillo; common on P. hydropiperoides in all parts of the state.

CINTRACTIA Cornu.

C. axicola (Berk.) Cornu.
On Fimbristylis autumnalis, Biloxi and Ocean Springs.

C. Junci (Schw.) Tul.
On Juncus acuminatus, Ocean Springs and Pointe du Chene.

C. Sorghi (Sorok) DeT.
On Sorghum vulgare (Chicken corn), Starkville. Collected in 1888, but not observed since.

ENTYLOMA DeB.

E. Physalidis (K. & C.) Wint.
On Physalis angulata, Artesia.

SOROSPORIUM Rud.

S. Ellisii Wint.
On Andropogon macrourus, A. scoparius, and A. Virginicus, Starkville; A. Virginicus, Ocean Springs.

S. Everhartii E. & G.
On Andropogon Virginicus, Saltillo and Starkville.

CEREBELLA Ces.

C. Andropogonis Ces.

On Sorghum nutans, Jackson and Saltillo; and Andropogon tener, Biloxi.

C. Paspali C. & M.

On Panicum virgatum, Ocean Springs; Paspalum platycaule, Jackson, Ocean Springs and Starkville. We also find a Cerebella on Anthaenantia rufa at Ocean Springs which perhaps belongs to this species, though the spore masses are much larger and more deeply folded and wrinkled than in the type.

C. Spartinæ E. & E.

On Brizopyrum spicatum, Ocean Springs, and Spartina gracilis, Biloxi, Ocean Springs and Pointe du Chene. Described in Proc. Phila. Acad. Nat. Sci., 1893, p. 156, as follows:

"Stromata small (2-4 mm.), thin, subconfluent, extending along one side of the spike, often for its entire length, gyrose, or porose, plicate, dark olive. Primary spores ovate or globose, 6-10μ diam., pale, with the epispore minutely granular, compound spores subquadrate, composed of 3-4 of the primary spores, brown, 12-16μ diam., mostly with a short thick pedicel. Differs from C. Andropogonis in habit and from C. Paspali in its smaller and differently shaped spores."

PERONOSPORACEÆ.

ALBUGO Pers.

A. Amaranthi (Schw.) OK.

On Amaranthus crispus, Starkville.

A. candidus (Pers.) OK.

On Nasturtium sessiliflorum, Saltillo; Capsella Bursa-pastoris, Cardamine Ludoviciana and Lepidium Virginicum, Starkville.

A. Ipomœa-pandurata (Schw.) Swingle.

On Calystegia sepium, Ipomœa pandurata and Quamoclit vulgaris, Starkville; common on I. Batatas everywhere.

A Portulaccacæ (DC.) OK.

On Portulacca oleracea, Starkville,

PLASMOPARA Schroet.

P. Geranii (Pk.) B. & DeT.
On Geranium Carolinianum, Ocean Springs and Starkville. Very abundant early in the season.

P. **Gonolobii** (Lag.) Swingle.
On Gonolobus macrophyllus, Starkville.

P. **Halstedii** (Farl) B. & DeT.
On Bidens frondosa, Saltillo; Gnaphalium purpureum, Ocean Springs.

P. **Viticola** (B. & C.) B. & DeT.
On Vitis sps. Especially severe on Delaware, Triumph, and vinifera varieties at Ocean Springs. Rare at Starkville, having been observed but once in 1891, and a careful search since then having failed to discover additional specimens.

PERONOSPORA Corda.

P. Alsinearum Casp.
On Cerastium viscosum and C. vulgatum, Starkville.

P. Arthuri Farl.
On Œnothera biennis, Starkville.

P. Myosotidis DBy.
On Myosotis verna, Starkville.

P. Violæ DBy.
On Viola tricolor var. arvensis, Starkville.

CHYTRIDIACEÆ DeB. & Wor.

SYNCHYTRIUM DeB.

S. decipens Farl.
On Desmodium canescens, Vicksburg.

S. fulgens Schroet.
On Œnothera fruticosa, Starkville.

S. Plantagineum Sacc.
On Plantago lanceolata, Starkville.

ERYSIPHEÆ Lev.

PODOSPHÆRA Kunze.

P. Oxyacanthæ (DC.) DeB.
On Cratægus coccinea, Starkville. Common on various

species of Cratægus throughout the northern and central parts of the state, but not observed on other Rosaceous hosts.

SPHAEROTHECA Lev.

S. lanestris Hark.

On Quercus alba, Q. minor, Q. Prinus, and Q. rubra. Starkville. Abundant in 1891, when it also appeared in Iowa, Illinois and Alabama. It had not previously been reported from east of the Rocky Mountains, and diligent search has failed to detect it here since.

S. Mors-uvæ (Schw.) B. & C.

On Ribes uva-crispa, Starkville.

S. pruinosa C. & P.

On Rhus glabra, Starkville. This is included somewhat doubtfully, as mature perithecia have not been found, but the characters of the mycelium and conidia agree fully with those of authentic specimens.

PHYLLACTINIA Lev.

P. **suffulta** (Reb.) Sacc.

Very common on leaves of various trees.

UNCINULA Lev.

U. flexuosa Pk.

On Æsculus glabra, Starkville.

U. macrospora Pk.

On Ulmus alata, Jackson and Starkville.

U. necator (Schw.) Burrill.

This is the ordinary powdery mildew, and formerly known as U. spiralis Berk. and U. ampelopsidis Pk. It occurs occasionally throughout the state.

U. parvula C. & P.

On Celtis occidentalis, Starkville.

U. polychæta (B. & C.) Tracy & Gal.

On Celtis occidentalis, Starkville.

U. salicis (D.C.) Wint.

On Salix nigra, Madison.

MICROSPHÆRA Lev.

M. Alni (DC.) Wint.
On Carya alba, Platanus occidentalis and Syringa vulgaris, Starkville; Tecoma radicans, Ocean Springs.

M. diffusa C. & P.
On Lespedeza striata and Desmodium sp., Starkville.

M. Euphorbiæ (Pk.) B. & C.
On Euphorbia corollata, Crystal Springs, Ocean Springs and Starkville; E. Preslii, Starkville.

M. **Quercina** (Schw.) Burrill.
Abundant on various species of Quercus in all parts of the state. We also have several collections of the form described by Atkinson as M. calocladophora, but we are unable to separate them from some of the many forms included under M. Quercina.

M. Ravenelii Berk.
On Apios tuberosa, Saltillo; Gleditschia triancanthos, Starkville. The forms of Microsphæra occurring on Leguminosae are often perplexing, and our specimens on Apios are referred here with some hesitation. The tips of the appendages are not recurved, and the method of branching approaches somewhat closely that in M. diffusa, but the short, rigid, and often partially colored appendages are those of M. Ravenelii.

ERYSIPHEÆ Hedw.

E. Cichoracearum DC.
On Ambrosia Artemisæfolia, A. trifida; Aster, sp., Helianthus, sp., Xanthium strumarium; Verbena angustifolia and V. Urticæfolia, Starkville.

E. communis (Wallr.) Fr.
On Desmanthus brachylobus, Cassia Chamæcrista, Œnothera biennis, Pisum sativum, Ranunculus abortivus and R. parviflorus, Starkville.

E. graminis DC.
On Poa pratensis, Starkville.

E. Liriodendri Schw.
On Liriodendron tulipifera, Starkville.

PERISPORIEÆ Sacc.

EUROTIUM Lk.

E. herbariorum (Wigg.) Kk.
Common.

ASTERULA Sacc.

A. Tracyi Peck.
On Borreria micrantha, Biloxi. Described in 47th Rep. N. Y, State Museum Nat. Hist., as follows:
"Subiculum thin, hypophyllous, composed of slender flexuous septate colored filaments about .00016 in. thick; perithecia very minute, .004 to .005 in. broad, hemispherical or depressed, subastomous, black; asci oblong-clavate, .0011 to .0014 in. long, .0003 to .0004 broad; spores oblong, slightly narrowed toward one end, obscurely 2- to 4-nucleate, colorless, .0003 to .0004 in. long, .00012 to .00015 broad."

ASTERINA Lev.

A. delitescens E. & M.
On Persea palustris, Columbus and Ocean Springs.

A. granulosa (Ve.)
On living leaves of Magnolia glauca, Ocean Springs. Our specimens were determined as above by Dr. Winter. The perithecia are epiphyllous, very large, black, carbonaceous. Asci not observed. Sporidia about 20 to 30μ, dark brown, opaque, uniseptate, not constricted. Often somewhat curved.

A. Ilicis Ellis.
On Ilex opaca, Columbus. Immature specimens so determined by Ellis.

A. pelliculosa Berk.
On Ilex coriacea, Biloxi and Ocean Springs; I. opaca, Madison and Ocean Springs.
This has usually been referred to A. orbiculare B. & C. but it differs in being usually epiphyllous and somewhat effused. The asci are broader, and the sporidia are broader, more constricted, and much darker colored. When fully mature they are densely opaque and the epispore somewhat echinulate.

ASTERELLA Sacc.

A. carnea (E. & M.) Sacc.
On Persea palustris, Ocean Springs.

A. cuticulosa (Cke.) Sacc.

On Ilex opaca, Ocean Springs.

Our specimens agree with the published descriptions of this species except that the asci and spores are larger. Our sporidia measure 8-10 by 24-30μ, while Saccardo says 5 by 10μ.

A. intricata (E. & M.) Sacc.

On Quercus sp., Ocean Springs.

Other perithecia very much resembling those of the Asterella were found on the under side of the leaves but they contained narrow cylindrical asci accompanied by abundant paraphyses. The sporidia were not sufficiently mature for determination.

DIMEROSPORIUM Fckl.

D. Magnoliæ Tracy & Earle.

On Magnolia glauca, Ocean Springs. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:

"Epiphyllous, on small indefinite areas; mycelium of dark brown, irregular, branching and septate hyphae; conidia clavate, dark colored, 4-5 septate, 7-8 by 45-55μ; peritheica depressed-hemispherical, black, usually in clusters of 5 to 10, astomous, 50-100μ; asci numerous, broadly oval or obovate, 8-spored, 35-40 by 45-50μ; paryphysate, paraphyses thread-like, colored toward the tips; sporidia biseriate, at first hyaline, dark-fuliginous when mature, obovate, 1-septate, constricted, 9-10 by 20-23μ."

D. pulchrum Sacc.

Conidia only. On Fraxinus, sp., and Rhus glabra, Starkville.

D. tropicale Speg.

Parasitic on Meliola amphitrica on leaves of Magnolia glauca and on Meliola bidentata on leaves of Bignonia capreolata, Ocean Springs.

PARODIELLA Speg.

P. **perisporioides** (B. & C.) Speg.

On Desmodium canescens, Vicksburg; Rhynchosia Memnispermoides, Biloxi, Ocean Springs, Poplarville and Starkville.

MELIOLA Fr.

M. amphitrica Fr.
On Cladium effusum, Olea Americana and Persea palustris, Ocean Springs; Magnolia glauca, Biloxi and Ocean Springs.

M. Araliæ (Spreng.) Mont.
On Magnolia glauca, Ocean Springs. These specimens were collected in 1887, and were identified by Dr. Winter.

M. bidentata Cke.
On Bignonia capriolata, Ocean Springs and Starkville.

M. manca E. & M.
On Myrica cerifera, Ocean Springs.

M. Mitchellæ Cke.
On Mitchella repens, Ocean Springs.

M. palmicola Wint.
On Sabal Adansonii, Biloxi, and S. serrulata, Ocean Springs.

CAPNODIUM Mont.

C. grandisporum E. & M.
On Gelsemium sempervirens, Ocean Springs. Our specimens are undoubtedly the same thing which is figured and described by Ellis under the above name (N. A. Pyromycetes p. 50, pl. 7) though they show no pycnidia. Ellis says "whether the subulate pycnidial perithecia belong to this is uncertain." We do not see on what grounds this is referred to Capnodium, as the globular perithecia are depressed rather than vertically elongated. Its multiseptate hyaline sporidia and general Meliola-like aspect, suggest Saccardo's new genus Zukalia, but as our specimens do not seem to be quite mature we prefer not to express a decided opinion.

ASTERIDIUM Sacc.

A. Illicii Tracy & Earle.
On Illicium Floridanum, Ocean Springs and Biloxi. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:

"Hypophyllous: mycelium none; perithecia black, scattered, orbicular, aplanate, membranaceous, cellular, not radiant, fragile, wrinkled, 200-400μ; asci numerous, suborbicular, 8-spored, 30-40μ; sporidia subpyriform, often

curved, granular, colorless, at first uniseptate, becoming 3-septate at maturity.

SPEÆRICAEÆ Fr.

DIATRIPELLA Ces. & DeN.

D. nigro-annulata (Grev.) Nits.
On dead limbs, Ocean Springs.

XYLARIA Hill.

X. polymorpha (Pers.) Grev.
On elm log, Starkville.

LÆSTADIA Auersw.

L. Illiciicola Tracy & Earle.
On Illicium Floridanum, Ocean Springs. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:

"Amphigenous, occupying large, irregular, brownish subarid, definitely limited areas, usually involving the apical half of the leaf; perithecia very numerous, scattered, erumpent, more abundant on the upper surface, black, membranaceous, suborbicular or lenticular, obscurely ostiolate, finally collapsing; asci without paraphyses, clavate, stipitate, thickened at apex, 40-50 by 10-12μ; sporidia ovoid or fusiform, continuous, hyaline, granular, about 15 by 5μ."

PHYSALOSPORA Niessl.

P. Arthuriana Sacc.
On Ambrosia Artemisiaefolia, Ocean Springs; Baccharis sp., Deer Island.

In our specimens on Ambrosia the perithecia are scattered, not on definite spots, and on Baccharis the asci and spores are broader. Otherwise they agree well with Arthur's specimens on Iva.

P. Bidwellii (Ell.) Sacc.
On various species and varieties of grape, causing Black-rot. Abundant in the northern and central portions of the state, not so far observed in the coast region.

P. Cynodontis Del.
On Brizopyrum spicatum, Horn Island.

TRABUTIA Sacc. & Roum.

T. Quercina (Fr. & Rud.) Sacc. & R.
On Quercus virens and other species, Ocean Springs.

SPHAERELLA Ces. & DeNot.

S. Andromedae Tracy & Earle.

On Andromeda nitida, Ocean Springs. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:

"Hypophyllous; spots none; perithecia abundant, scattered, often covering the entire lower surface of the leaf, black, erumpent, ostiolate, at length collapsing; asci obovate, somewhat thickened at the apex; sporidia oval, hyaline, uniseptate, cells about equal, 7-8 by 2. 5-3μ."

GNOMONIA Ces. & DeN.

G. Andropogonis E. & E.

On Andropogon Virginicus, Starkville.

ENDOTHIA Fr.

E. gyrosa (Schw.) Fckl.

On old stump, Ocean Springs.

LEPTOSPHÆRIA Ces. & DeNot.

L. albopunctata (West) Sacc.

On Juncus maritimus, Ocean Springs.

L. obtusispora Speg.

On Yucca sp., Starkville.

This is not L. filamentosa E. & E., as in that species the sporidia are 3-septate, while in our specimens they are uniformly 5-septate. L. obiusispora Speg. from Argentina is described as without paraphyses (Sacc. Syl. II, p. 74.) In our specimens paraphyses are abundant, but it agrees so closely with the description in other respects, especially in the very obtuse sporidia having the third lower medial cell enlarged, that we have determined it as above.

PLEOSPORA Rab.

P. Americana E. & E.

On Lathyrus sativus and Pisum sativum, Starkville. This was first described by Ellis & Everhart from Mississippi specimens in Proc. Phil. Acad. Sci. 1890, p. 238, as P. hyalospora, but as that name had been previously used by Spegazini for another species of Pleospora, it is given in Ellis' Pyrenomycetes p. 336 under the above name, and is there described as follows:

"Perithecia scattered, depressed-hemispherical. 75-90μ, of coarse cellular structure, at first sunk in the parenchyma of the leaf, finally more or less erumpent-superficial, with a

papilliform ostiolum. Asci oblong, 75-85 by 35-40μ, 8-spored. Sporidia oblong or slightly ovate-oblong, 3-5-septate (mostly 5-septate), with one or more longitudinal septa more or less distinct, nearly hyaline, ends obtusely pointed or rounded, slightly constricted at the septa, especially at the middle one, 25-40 (mostly 25-30) by 12-15μ. Differs from P. Pisi (Sow.) in its obovate asci, nearly hyaline sporidia, and more delicate, smaller perithecia."

HYPOCREACEÆ DeN.

CLAVICEPS Tul.

Sclerotia which should probably be referred here have been collected on Anthænantia rufa, Panicum virgatum, Phleum pratense and Spartina glabra, but in the absence of the ascigerous form we have not attempted to identify them.

EPICHLOE Fr.

E. typhina (Pers.) Tul.
On Glyceria nervata, Starkville.

HYPOCRELLA Sacc.

H. Hypoxylon (Pk.) Sacc.
On Andropogon provincialis, Biloxi; Aristida purpurascens and Panicum agrostoides, Ocean Springs; Aristida stricta, Starkville; Panicum anceps, Durant.

var pilulæformis B. & C.
On Uniola gracilis, Ocean Springs.

DOTHIDIACEÆ Nits. & Fckl.

PHYLLACHORA Nits & Fckl.

P. graminis (Pers.) Fckl.
On various grasses. Common everywhere.

P. Rosæ (Schw.) Sacc.
On Rosa Carolina, Starkville.

P. Solidagineum (Schw.) Sacc.
On Solidago, sp., Durant and Holly Springs.

DOTHIDELLA Speg.

D. Aristidæ (Schw.) Ellis.
On Aristida purpurascens, Ocean Springs.

D. scutula (B. & C.) Sacc.
On Persea palustris, Ocean Springs.

MONTAGNELLA Speg.

M. heliopsidis (Schw.) Ell.
On Helianthus sps., Holly Springs and Starkville.

MYRIANGIUM Mont. & Berk.

M. Eurieni Mont. & Berk.
On Gleditschia triancanthos, Starkville.

HYSTERIACEÆ Corda.

LEMBOSIA Lev.

L. **angustiformis** Tracy & Earle.
On Ilex coriacea, Biloxi and Ocean Springs. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:
"Epiphyllous, on raised, brown, irregularly stellate blisters; mycelium scanty; perithecia black, long and narrow, often flexuous, seldom branched, 60-80 by 175-300μ; subiculum reduced to a few short, flexuous, slightly fuscous, branching threads; asci broadly oval, about 15 by 18μ; sporidia obovate, somewhat unequally uniseptate, constricted, at first hyaline, becoming light fuliginous, 8-10 by 4-5μ." This differs widely from L. Prinoides in gross appearance on the leaf, in the narrower perithecia, less conspicuous subiculum and smaller asci and sporidia.

L. **Illiciicola** Tracy & Earle.
On Illicium Floridanum, with Asteridium Illicii, Ocean Springs. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:
"Epiphyllous on large light brown orbicular or irregular undeterminate areas. Perithecia numerous, superficial, carbonaceous, usually linear and strict, occasionally triangularly stellate, 100 by 300-400μ. Subiculum of light brown, flexuous, transparent, continuous, variously branching and anastamosing threads. Asci very numerous, oval or ovate, 8-spored, 25-30 by 12μ. Sporidia oval, uniseptate, slightly constricted, ends obtusely rounded, hyaline, at length slightly colored, 8-10 by 3-4μ."

L. **Prinoides** Tracy & Earle.
On Ilex coriacea, Ocean Springs. Described in Bul. Torr, Club, Vol. 22, No. 4, as follows:
"Epiphyllous on orbicular pallid spots; mycelium scanty, brown; perithecia scattered, black, subcarbonaceous, fim-

briate margined, elliptical, subacute, often forking, 120-150 by 200-350μ. Subiculum of dark brown, irregular, nodular, usually continuous and branching brittle threads. Asci ovate, 8-spored, 30-35 by 15-18μ. Sporidia elliptical, unequally uniseptate, somewhat constricted, subhyaline, becoming fuligenous 10-15 by 4-5μ."

The asci and spores are much as in L. Illiciicola, but they are uniformly larger, the perithecia are usually broader, and the subicular threads are darker, more brittle, and less flexuous, and interwoven, while the appearance on the leaf is entirely different.

L. quercina (E. & M.) Tracy & Earle.
On Quercus virens, Ocean Springs.

This is Aulographum Quercinum E. & M., which is described with hyaline sporidia. It is not given by Saccardo. In our specimens, which are probably more mature, the sporidia are dark brown, unequally uniseptate, and measure 8 by 15-20μ. This, with the fringe-like subiculum, places it in Lembosia as the genera are defined by Saccardo. L. lituræ (Cke) Sacc. differs in the much smaller sporidia 3.5 by 7.5μ.

TRYBLIDIELLA Sacc.

T. rufula (Spreng.) Sacc.
On dead limbs, Ocean Springs.

ACROSPERMUM Tode.

A. compressum Tode.
On Agrostis perennans, Starkville.

DISCOMYCETES Fr.

GEOGLOSSUM Pers.

G. velutipes Pk.
On ground in woods, Biloxi and Ocean Springs.

DASYSCYPHA Fr.

D. lachnoderma (Berk) Rehm.
On dead twigs, Ocean Springs.

STICTIS Pers.

S. helicotricha E. & E.
On Arundinaria tecta, Starkville.

Described in Proc. Acad Nat. Sci. Phila., 1893, p. 151, as follows: "On leaves and sheaths; purplish-black

throughout, about ½ mm. diam., closed at first, at length opening with a small round mouth with the entire border scarcely prominent. The base of the ascoma projects in a pustuliform manner on the other side of the leaf. Asci subcylindrical, attenuated above, 150-170 by 6μ, with abundant filiform paraphyses broadly recurved at their tips. Sporidia filiform, about as long as the asci, interwoven, multinucleate, becoming multiseptate 1-1.5μ thick. Differs from S. Arundinacea Pers. in lacking the prominent, white border around the mouth, and in the strongly recurved tips of the paraphyses and rather narrower sporidia.

The specific name alludes to the strongly recurved and subinvolute tips of the paraphyses."

PSEUDOPEZIZA Fckl.

P. Medicaginis (Lib.) Sacc.
On Medicago sativa, Melilotus alba and Vicia villosa, Starkville.

P. Trifolii (Biv. & Bernh.) Fckl.
On Trifolium repens, Starkville.

RHYTISMA Fr.

R. Acerinum (Bers.) Fr.
On Acer rubrum, Durant and Ocean Springs.

R. Vaccinii Fr.
On Vaccinium arboreum. Common.

TAPHRINA Fr.

T. coerulescens (D. & M.) Tul.
On various species of Quercus. Common.

EXOASCUS Fckl.

E. deformans (Berk.) Fckl.
Common on Peach, Starkville.

E. Pruni Fckl.
On Prunus Americana, Madison and Starkville.

ASCOMYCETELLA.

A. ————
Conidia only have been observed on many species of oak throughout the state.

FUNGI IMPERFECTI.

PHYLLOSTICTA Pers.

P. Aesculi E. & M.
On Æsculus pavia, Starkville and Ocean Springs.

P. Asimineæ E. & K.
On Asimina triloba, Starkville.

P. Fraxinicola Carr.
On Fraxinus Americana, Starkville.

P. Gossypina E. & M.
On Gossypium hirsutum, Starkville.

P. hortorum Speg.
On Solanum melongena, Ocean Springs and Starkville.

P. Labruscae Thum.
On Vitis bipinnata, V. vulpina, Ocean Springs; Ampelopsis quinquefolia, Vitis cordifolia, Starkville; common on cultivated varieties of Vitis.

P. latifolia E. & E.
On Kalmia latifolia, Ocean Springs.

P. palmetto E. & E.
On Sabal Adansonii, Leland.
Described in Jour. Mycol. Vol. V, No. 3, as follows:
"On leaves of Sabal palmetto, Louisiana, April, 1886. (Langlois, 426 in part). On the same host at Leland, Miss., April, 1889 (Tracy, 1206). Spots subelliptical, $\frac{1}{2}$ to 1 by $\frac{1}{4}$ to $\frac{1}{2}$ centimeter, pallid, with a yellowish shaded border. Perithecia amphigenous, pustuliform, 110-150μ in diameter, lead colored, of fine cellular structure, with a small round opening in the center. Sporules cylindrical; obtuse, 2–3 nucleate, hyaline, 12-14 by $2\frac{1}{2}$-3μ. The perithecia resemble minute blisters. Probably the spermagonial stage of Sphaerella sabaligena E. & E., with which it was mixed in the Louisiana specimens."

P. **Pirina** Sacc.
On Pirus malus, Starkville.

P. **Podophylli** (Curt) Wint.
On Podophyllum peltatum, Starkville.

P. **Ruborum** Sacc.
On Rubus villosus, Ocean Springs.

P. **Sassafras** Cke.
On Laurus sassafras, Starkville and Vicksburg.

P. **sinuata** E. & M.
On Olea Americana, Ocean Springs.

P. **Tecomæ** Sacc.
On Tecoma radicans, Starkville.

P. **terminalis** E. & M.
On Ilex opaca, Ocean Springs.

P. Ulmicola Sacc.
On Ulmus alata, Starkville.

P. virens E. & L.
On Quercus virens, Horn Island.

PHOMA Fr.

P. **glumarum** Ell. & Tracy.
On Oryza sativa, Starkville; Uniola latifolia, Ocean Springs and Starkville; U. paniculata, Ocean Springs.
Described in Jour. Mycol. Vol. IV, No. 12, as follows:
"On living glumes, perithecia erumpent-superficial, black, minute (90-100μ), pierced above. Sporules elliptical, 3-4 by 3-2½μ, smokey hyaline."

P. **graminella** Sacc.
On Bromus secalinus, Starkville.

P. **maculans** (B. & C.) Sacc.
On Bumelia sp., Ocean Springs.

VERMICULARIA Fr.

V. affinis Sacc. & B.
On Andropogon Halli, Bromus madritensis, Dactylis glomerata and Elymus Virginicus, Starkville; Panicum Crus-galli, Gibson, Martin, (J. M. White), and Starkville; Sisyrinchium Bermudianum, Starkville.

V. Stachydis Tracy & Earle.
On Stachys affinis, Starkville. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:
"Perithecia scattered, subsuperficial; setæ somewhat floccose and nodular, septate, olivaceous, pale towards the tips which are obtuse and slightly enlarged; conidia falcate, attenuate at each end but without evident basidia, guttate, at length faintly 4-5 septate, 35-40 by 3-4μ."
This differs from other described species in the larger,

at length several septate conidia, and the weak, rather light colored setæ with swollen tips.

CONIOTHIRIUM Corda.

C. Fuckelii Sacc.
On Smilax Bon-Nox, Starkville.

DIPLODIA Fr.

D. hesperiderica Speg.
On Citrus vulgaris, Ocean Springs.

D. minuta Tracy & Earle.
On living stems of Tecoma radicans, with Pestalozzia breviaristata, Starkville. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:

"Scattered over indeterminate, whitened areas; perithecia erumpent, small, 90-120μ, membranaceous, smooth, ostiolate; sporules minute, oval, uniseptate, not constricted, light yellow, 6-8 by 3-4μ."

D. Sassafras Tracy & Earle.
On living twigs and branches of Sassafras, Starkville. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:

"Perithecia very numerous over large areas, black, hemisperical, erumpent, finally opening by an irregular fissure; sporules numerous, ovate, fuscous or nearly black, with a very distinct hyaline septum near the smaller end, 13-14 by 5-6μ."

ASCOCHYTA Lib.

A. Pisi Lib.
On pods of Pisum sativum, Ocean Springs.

ACTINONEMA Fr.

A. Rosæ (Lib.) Fr.
On cultivated roses, Ocean Springs and Starkville.

DARLUCA Cast.

D. filum (Biv.) Cast.
Common on Uredineæ, especially on Carices.

HENDERSONIA Ces.

H. Sabaleos Ces.
On Sabal Adansonii, Ocean Springs.

H. Taphrinicola Tracy & Earle.

On old, whitened blisters of Taphrina on Quercus virens, Ocean Springs. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:

"Epiphyllous, on white bordered spots; perithecia scattered, black, erumpent, at length collapsing; conidia truncate, cylindrical, fuliginous, 2-septate, constricted at the septa, 12-14 by 4-5μ."

HENDERSONULA Speg.

H. Aristidæ (Sz.) Ellis, in lit.

(Dothidia aristidæ Sz.)

On Aristida purpurascens, Ocean Springs.

Ellis says, "I find in the minute cells in the stroma oblong 12-14 by 3.5-4μ sporules, at first hyaline and 1-septate, becoming brown and 3-septate."

STAGONOSPORA Sacc.

S. Cyperi Ell. & Tracy.

On culms of Cyperus cylindricus, Starkville. Described in Proc. Acad. Nat. Sci., Phila. 1891, p. 81, as follows:

"Perithecia minute, globose, crowded, forming pustuliform groups 1 mm. or more in diameter beneath the cuticle which becomes brown above them and finally splits open, exposing the tobacco-brown perithecia. Sporules fusoid, hyaline, 12-16 by $2\frac{1}{2}$-3μ, 2–3 nucleate."

S. intermixta Cke.

On Poa arachnifera, Starkville.

S. septorioides E. & E.

On dead leaves of Quercus imbricaria, Starkville. Described in Jour. Mycol., Vol. IV, p. 45, as follows:

"Perithecia innate-erumpent, small, hypophyllous; sporules cylindrical, subhyaline, 3-9 septate, 15-25 by 1μ, oozing out and staining the leaf around the perithecia."

KELLERMANIA Ell. & Ev.

K. Yuccægena E. & E.

On Yucca (gloriosa ?), Starkville.

SEPTORIA Fr.

S. Bromi Sacc.

On Elymus Virginicus and E. Canadensis, Starkville.

S. Cerastii Rob. & Desm.
On Cerastium arvense, Starkville.

S. consimilis E. & M.
On Lactuca sativa, Starkville.

S. Gossypina Cke.
On Gossypium hirsutum, Starkville.

S. Lepidicola E. & M.
On Lepidium Virginicum, Starkville.

S. polaris Karst.
On Ranunculus parviflorus, Starkville.

S. Ranunculacearum Lev.
On Ranunculus pusillus, Starkville.

S. rhoina B. & C.
On Rhus typhina, Martin.

S. Specularіæ B. & C.
On Specularia perfoliata, Starkville.

LEPTOTHYRIUM Kunze & Schw.

L. dryinum Sacc.
On Quercus aquatica, Ocean Springs.

L. Spartinæ Pk.
On Spartina juncea, Biloxi. Described in 47th Report N. Y. State Mus Nat. Hist., as follows:

"Perithecia minute, depressed, suborbicular, elliptical, oblong, sometimes confluent in series, rugulose, black, brownish on the margin, easily separable from the matrix; spores narrowly elliptical, subacute, hyaline .0005 to .0006 in. long, .0002 to .0003 broad, usually containing a single large nucleus, adorned with a filiform appendage at each end."

Peck says "This is a very distinct species and one that departs from the usual characters of the members of the genus, in its large spores and their filiform appendages. These are sometimes longer than the spore itself. The thin margins of the perithecia have a radiate structure."

PIGGOTIA B. & Br.

P. astroidea B. & Br.
On Ulmus Americana, Starkville.

P. Fraxini B. & C.
On Fraxinus Americana, Starkville and Jackson.

MELASMIA Lev.

M. hypophylla (B. & R.) Sacc.
On Gleditschia triacanthos, Starkville.

DISCOSIA Lib.

D. maculicola Gerard.
On Smilax tamnifolia, Durant.

AMEROSPORIUM Speg.

A. Caricinum (Lib.) Sacc.
On Carex riparia, Starkville.

A. œconomicum Ell. & Tracy.
On Dolichos Sinensis, Biloxi and Starkville. Described in Jour. Mycol. Vol. IV, p. 102, as follows:
"Spots orbicular, 2-6 mm. diam., white above with a reddish border, mostly entirely red below. Perithecia epiphyllous, erumpent, conic-hemispheric, broadly perforated above, beset with straight, spreading, grayish-black, septate bristles 100-150 by 4μ. Sporules oblong-fusoid, nucleate, 18-27 by 4μ."

DINEMASPORIUM Lev.

D. gramineum Lev.
On Panicum Crus-galli, Starkville.

GLŒOSPORIUM Desm. & Mont.

G. lindemuthianum S. & M.
On Citrullus, Starkville and Ocean Springs.

G. nervisequum (Fckl) Sacc.
On Liquidambar styraciflua, Martin.

G. Rubi E. & E.
On Rubus villosus, (With uredo of Cæoma nitens) Starkville. Described in Jour. Mycol. Vol. IV, p. 52, as follows:
"Amphigenous on large indefinite brown spots and areas of the leaf, partly overrun by the Cæoma; acervuli numerous, small; conidia oblong, continuous, hyaline, 10-16 by 4μ, mostly rounded at the ends and straight, but some of them slightly curved and a little narrower at the end."

G. Septorioides Sacc.
On Quercus Prinus, Starkville.

G. Violæ B. & Br.
On Viola odorata, Starkville.

COLLETOTRICHUM Corda.

C. Gossypii Smith.
On Gossypium hirsutum. Starkville.

CYLINDROSPORIUM Ung.

C. angustifolia E. & K.
On Yucca glauca, Starkville.

C. **Rubi** E. & M.
On Rubus occidentalis, Starkville.

C. **Ulmicolum** E. & E.
On Ulmus alata, Starkville. Described in Proc. Acad. Nat. Sci., Phila., p. 372, 1894, as follows:

"Acervuli numerous, small, pale, buried in yellowish, faded areas of the leaf, visible from above, but erumpent below. Conidia cylindrical, moderately curved, slightly narrowed toward the ends, hyaline, multinucleate, 45-65 by 4μ, expelled in small white tufts, on the lower side of the leaf."

PESTALOZZIA DeNot.

P. breviaristata Tracy & Earle.
On living stems of Tecoma radicans, with Diplodia minuta, Starkville. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:

"Acervuli scattered over indefinite, whitened areas, black, at length collapsing; conidia curved, elliptical, 5-septate, apical and basal cells colorless, medial cells fuscous, septa often diagonal, 25-27 by 7-8μ; stipe hyaline, half the length of the conidium, somewhat swollen at the base, often deciduous; arista single, strongly oblique, thickened, scarcely one-fourth the length of the conidium."

P. Cliftoniae Tracy & Earle.
On living leaves of Cliftonia ligustrina, Ocean Springs. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:

"Epiphyllous on orbicular, arid, brown, bordered spots. Acervuli scattered, bursting through the dried epidermis; conidia obovate, sometimes curved, 4-septate, septa often oblique, three medial cells fuliginous, the two upper ones dark and opaque, the lower one paler, basal cell colorless, small, short, acute, abruptly contracted to the short stipe; apical cell reduced to a short colorless apiculus bearing the three widely divergent setæ, 16-18 by 8μ, setæ 12-14μ."

P. funeria Desm.
On Smilax sp., and S. laurifolia, Ocean Springs.

P. taphrinicola E. & E.
On Quercus aquatica, Biloxi; Q. virens, Ocean Springs.

SEPTOGLOEUM Sacc.

S. profusum (E. & E.) Sacc.
(Glœosporium profusum E. & E.)
On Corylus Americana, Vicksburg; and Ulmus Americana, Starkville. Described in Jour. Mycol. Vol. IV, p. 104, as follows:
"On living leaves of Corylus Americana; acervuli scattered, hypophyllous, large, cirri white, profuse. Spores cylindric-oblong, granular and 3-septate, 25-30 by 6-6μ. The leaf is mottled with yellow specks above. G. rostratum E. & E. is on definite spots and has longer narrower spores."

MICROSTROMA Niessl.

M. Juglandis (Ber) Sacc.
On Carya alba, Starkville.

OOSPORA Wallr.

O. Tulipiferæ E. & M.
On Liriodendron tulipifera, Martin (J. M. White.)

MONILIA Pers.

M. fructigena Pers.
Very common, and especially injurious to peaches and plums.

OIDIUM Lk.

O. Erysiphoides Fr.
Common on many species everywhere.

RAMULARIA Ung.

R. occidentalis E. & K.
On Rumex crispus, Starkville.

R. Tulasnei Sacc.
Common on strawberries, but not so injurious as in the northern states.

R. virg-aurea Thum.
On Aster sp., Starkville.

CERCOSPORELLA Sacc.

C. Persica Sacc.
On Prunus Persica. Common everywhere, often causing the leaves to drop in midsummer.

CONIOSPORIUM Lk.

C. Arundinellae E. & T.
On Arundinaria tecta, Starkville. Published as No. 2745, N. A. F.

C. rhizophyllum (Pr.) Sacc.
On roots of Cynodon Dactylon, Starkville.

GLENOSPORA B. & C.

G. Curtisii B. & Desm.
On Gleditschia triacanthos, Starkville.

ELLISIELLA Sacc.

E. caudata (Pk.) Sacc.
On Andropogon Hallii, Starkville.

SCOLECOTRICHUM Kunze.

S. grmainis Fckl.
On Alopecurus geniculatus, Avena bulbosa and Dactylis glomerata, Starkville.

S. punctulatum Tracy & Earle.
On Iris pabularia, Starkville. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:

"Amphigenous; spots indefinite; hyphæ in small cæspitose clusters, irregularly flexuous and nodular, olivaceous, 2-3-septate, 60-90 by 5-6μ; conidia oval or oblong, ends obtusely rounded, fuscous, epispore distinctly granulate or punctulate, typically uni-septate but often continuous, and occasionally 3-septate, 15-20 by 6-8μ."

POLYTHRINCIUM Kunze.

P. Trifolii Kunze.
On Trifolium pratense, Starkville.

CLADOSPORIUM Lk.

C. fulvum
Common on Tomato everywhere.

C. velutinum E. & T.
On Phalaris Canariensis, Starkville.

Described in Jour. Mycol. Vol. VII, No. 2, as follows:

"Forming velutinous, olive-brown patches ½-1 centimeter long, or by confluence longer, slightly thickening and distorting the leaf; hyphæ erect, simple, septate, subundulate, pale brown, 50-75 by 4-5μ; conidia terminal, 8-20 by 4-5μ, 1-3-septate, subhyaline, the shorter ones elliptical, the longer ones oblong or cylindrical."

STIGMINIA Sacc.

S. Liriodendri E. & E.

On fading leaves of Liriodendron tulipifera, Saltillo. Described in Proc. Acad. Nat. Sci. Phila. 1893, p. 171, as follows:

"Spots amphigenous, subindefinite, dark brown, with a yellow shaded-border, 3-5 mm. diam. Acervuli numerous, hypophyllous, standing circumferentially on the spots so as to leave the center bare. Conidia oblong-cylindrical, brown, 1-3 (mostly 3) septate, 10-15 by 3½-4μ, not constricted at the septa, 3-4-or more catenulate, catenulæ sometimes branching above."

S. Platani (Fckl) Sacc.

On Platanus occidentalis, Jackson.

HELMINTHOSPORIUM Lk.

H. fumosum E. & M.

On Magnolia grandiflora, Columbus.

H. nodosum Cr.

On Eleusine Indica, Starkville.

H. Ravenelii C. & B.

On Eragrostis pilosa, Starkville. Very common on Sporobolus Indicus everywhere, giving it the common name of "smut grass."

CERCOSPORA Fr.

C. **Ageratoides** E. & E.

On Eupatorium rotundifolium, Biloxi.

C. **Asiminæ** E. & K.

On Asimina triloba, Starkville.

C. **Borreriea** E. & E.

On Borreria micrantha, Biloxi. Described in Proc. Acad. Nat. Sci., Phila., p. 379, 1894, as follows:

"Hypophyllous. Tufts effused, forming a thin, oliva-

ceous coating. Hyphæ slender, undulate or crisped and geniculate, 100-120 by 3-3½ μ, brown, nucleate and indistinctly and sparingly septate. Conidia slender, lanceolate, hyaline, 3-5-septate, 35-45 by 3-3½ μ."

C. **cæspitosa** E. & E.

On Eustachus Petræa, Biloxi, Ocean Springs, Starkville. Described in Proc. Acad. Nat. Sci., Phila., 1891, p. 88, as follows:

"On living leaves, mostly hypophyllous, forming scattered brownish tufts ¼-⅓ mm. diam., and much resembling the sori of some Puccinia. Hyphæ densely tufted, deep brown, 3-5-septate, closely undulate and geniculate above. 70-100 by 4 μ. Conidia cylindrical-fusoid, slightly curved. hyaline, 20-35 by 3-3½ μ. C. striæformis Wint., to which this must be closely allied, grows in elongated tufts and has the conidia more slender."

C. **Cercidicola** Ell.

On Cercis Canadensis, Starkville.

C. **consociata** Wint.

On Ruellia ciliosa, Starkville.

C. **cruenta** Sacc.

On Dolichos sinensis, Starkville.

C. **Diospyri** (Thum) Cke.

On Diospyrus Virginiana, Jackson and Starkville.

C. **Dolichi** E. & E.

On leaves of Dolichos sinensis, Starkville. Described in Jour. Mycol, Vol. VI, No. 2, as follows:

"Amphigenous, but more abundant below. Hyphæ short 20-25 (exceptionallp 30-35) by 4-5 μ, olivaceous, entire or slightly toothed above, continuous or with one or two obscure septa, forming small but close tufts without any distinct tubercular base, the tufts scattered over almost the entire surface of the leaf, both on the reddish spots and on the green parts of the leaf, but unevenly distributed, so as to present a clouded or mottled appearance. Conidia slender obclavate, hyaline, 3-5 or more septate, 50-100 by 3½-5 μ. The spots are much like those of Amerosporium œconomicum E. & T. (Jour. Mycol. IV, p. 102) only are not white, but rusty red, or at most only whitish."

C. **Elephantopi** E. & E.

On Elephantopus Carolinianus, Starkville.

C. **erythrogena** Atks.
On Rhexia mariana, Biloxi and Ocean Springs.

C. **flexuosa** Tracy & Earle.
On leaves of Diospyros Virginiana, Biloxi and Ocean Springs. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:

"Forming large, indefinite, effused, patches on the under side of the leaf. Hyphæ ferruginous, irregularly flexuous throughout, sometimes branched, many septate, denticulate, 75-150 by 4-5μ; conidia obclavate, fuscous, 2-7, usually 3-4 septate, not constricted, 20-30 by 4-5μ."

This differs from C. Diospyri (Thum) Ck., in its septate hyphæ and much longer spores, and from other Cercosporas reported on the same host in the absence of the definite spots.

C. **fusco-virens** Sacc.
On Passiflora incarnata, Madison; P. lutea, Biloxi.

C. **Gossypina** Cke.
Common on cotton.

C. **graminicola** Tracy & Earle.
On dying leaves of Phleum pratense, Starkville. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:

"Spots none; amphigenous; most abundant on the midvein; hyphæ cæspitose, straight or somewhat flexuous, fuscous, 2-3-septate, 75-100 by 4-5μ; conidia clavate, continuous when young but finally becoming 1-3-septate, fuscous, 35-40 by 7.5-10μ."

C. **grisea** C. & E. (C. minuta of Saccardo).
On Polygala sanguinea, Saltillo; P. nana, Biloxi; Sabbatia angularis, Starkville.

C. **Hydrocotyles** E. & E.
On Hydrocotyle verticellata, Biloxi and Ocean Springs.

C. **Liriodendri** E. & H.
On Liriodendron Tulipifera, Crystal Syrings.

C. **Liquidambaris** E. & E.
On Liquidambar styraciflua, Durant and Martin.

C. **macroguttata** Atks.
On Chrysopsis graminifolia, Biloxi.

C. **Malloti** E. & E.
On Mallotus Japonicus, Starkville. Described in Jour. Mycol. Vol. IV, No. 11, as follows:

"Spots dirty white, subangular 1-4 mm. thin, deciduous. Hyphæ amphigenous, tufted, 35 by 3-4μ, brownish, continuous, denticulate, crooked. Conidia slender, 60-70 by 3μ, faintly septate, hyaline."

C. maritima Tracy & Earle.

On Croton maritimum, Horn Island. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:

"Amphigenous; not forming definite spots, but densely effused over considerable dark colored areas: hyphæ fasciculate, mostly straight, olive-brown, 5-6 septate, often swollen at the septa, 40-100 by 4-6μ; conidia paler, elongated, straight or slightly curved, mostly uniseptate, the upper cell shorter and broader then the lower, 50-60 by 5-7μ."

C. Medicaginis E. & E.

On Medicago maculata and M. sativa. Starkville.

C. Menispermi E. & H.

On Cocculus Carolinianus, Starkville.

C. Mikaniae E. & E.

On leaves of Mikania scandens, Tupelo. Described in Proc. Acad. Nat. Sci., Phila., 1891, p. 90, as follows:

"Hypophyllous. Hyphæ 100-120 by 4μ, septate, brown, subequal, fasciculate, more or less bent, sparingly toothed above, tufts effused, forming indefinite olive-brown patches, and more or less confluent over the entire lower surface of the leaf, but not on any definite spots. Conidia oblong-clavate, 3-5 septate, olivaceous; 40-85 by 5-6μ."

C. Mississippiensis Tracy & Earle.

On Smilax glauca and S. rotundifolia, Starkville. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:

"Amphigenous, but more abundant on the under side of the leaf; spots small, irregular, usually bounded by the veins, brownish, surrounded by an irregular raised and darker border having a palid outer margin; hyphæ divergent, irregularly floccose, nodular, usually uniseptate above the somewhat bulbous base, 60-70 by 5μ; conidia fuscous, narrowly clavate, tapering from the rather obtuse apex to the attenuated, filiform, nearly hyaline base, 4-8 or more septate, 75-150 by 4-5μ."

C. olivacea (B. & R.) Ell.

On Gleditschia triacanthos, New Albany, (A. B. Seymour.)

C. personata (B. & C.) Ell.
On Arachis hypogea, Biloxi, Ocean Springs, Saltillo, Starkville. Often quite injurious to the crop.

C. Pancratii E. & E.
On Crinum Americanum, Ocean Springs.

C. rhoina C. & E.
On Rhus glabra, Biloxi and Starkville.

C. sordida Sacc.
On Tecoma radicans, Ocean Springs and Starkville.

C. sparsa Cke.
On Kalmia latifolia, Ocean Springs.

C. tuberculans E. & E.
On leaves of Liquidambar styraciflua, Starkville. Described in Jour. Mycol. Vol. IV, No. 11, as follows:

"Forming rounded tubercles about 1 mm. diam., appearing first along the midrib and main nerves towards the tip of the leaf. These tubercles are of a light color inside but are thickly clothed on the surface with short, 25-35 by 4-5μ, continuous, erect, olivaceous hyphæ which are entire or slightly toothed above and near the subolivaceous, subcylindrical, 1-5-septate conidia, 30-75 by 4-5μ. This is very different from Cercospora liquidambaris C. & E., which is on definite spots."

This is a very distinct species, blackening and killing the entire leaf and making it appear as though charred. It has been collected from one tree during six consecutive seasons, but has not been obtained elsewhere.

C. Viticola (Ces) Sacc.
Common on all species of Vitis.

TETRAPLOA Berk.

T. divergens Tracy & Earle.
On living or languishing leaves of Panicum Agrostoides, Starkville. Described in Bul. Torr. Club, Vol. 22, No. 4, as follows:

"In black, irregularly linear masses; conidia broadly oval, dark fuliginous, 12-14 by 8-9μ, quarternately divided, each division usually 2-septate and terminated by an obtuse, semi-transparent, continuous, divergent, horn-like projection, 4-5μ in length."

MACROSPORIUM Fr.

M. commune Reb.

Common on dead plants everywhere.

M. nigranticum Atks.

On cotton.

M. Podophylli E. & E.

On old Aecidium Podophylli, Starkville. Described in Proc. Acad. Nat. Sci., Phila., 1891–'92, as follows:

"Mostly hypophyllous, effused, thin, the sterile or creeping pale brownish or subhyaline hyphæ sending up short (30-40 by 4-4μ), continuous or faintly septate, erect, subhyaline obtuse branches with clavate, yellow-brown, 1-5-septate, muriform, 30-40 by 10-12μ conidia prolonged below into a distinct pedicel."

M. Solani E & H.

On Datura stramonium, Lexington. (W. L. McGee.)

TUBERCULINA Sacc.

T. persicina (Dietm) Sacc.

On Æcidium Ranunculi, Starkville.

ILLOSPORIUM Mart.

I. roseum (Schreb) Mart.

On some Lichen, Starkville.

FUSARIUM Lk.

F. Celtidis Ell. & Tracy.

On galls on Celtis occidentalis, Starkville. Described in Jour. Mycol. Vol. VI, No. 2, as follows:

"Sporodochia scattered, erumpent, pulvinate, pale orange, $\frac{1}{4}$-1 millimeter in diameter. Basidia subfasciculately branched above, branches erect, 40-60 by 4μ, septate. Conidia fusoid, nearly straight, only the obtusely pointed ends slightly curved, 5 septate, 40-60 by 4-5μ."

F. heterosporum Nees.

On Paspalum dilatatum, Durant and Starkville; P. distichum, Jackson and Starkville.

F. roseum L.

On Paspalum distichum, Holly Springs and Starkville; P. Floridanum, Ocean Springs; decaying cotton bolls, Starkville.

EPICOCCUM Lk.

E. neglectum Desm.

On Oriza sativa and Poa arachnifera, Starkville.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 35.

HOG RAISING.

TAIT BUTLER.

AGRICULTURAL COLLEGE, MISS.,

SEPTEMBER, 1895.

The bulletins of the Station are sent free of charge to all farmers in Mississippi who apply for them.

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HOG RAISING.

There is no greater need in Mississippi to-day than for more first class swine, unless it be better methods of caring for those we already have. No system of farming has ever paid, or ever can pay, which does not give the hog a most important place in the economy of the farm. Until recently the people of the South have seemed to ignore this important fact, and even now are too feebly impressed with the necessity for the production of more and better pork at less cost. Of late, however, many have been taking more interest in swine breeding and feeding. This recently awakened and rapidly increasing interest in hog raising, and a general lack of knowledge on the part of many farmers as to the proper selection, care and feeding of swine so as to obtain the most profitable results, is the reason for issuing this bulletin.

Always keeping in mind that the "destiny of the hog is the pork barrel," and that the sole object in swine breeding is the production of a hog that will make the greatest amount of the best pork at the least cost for feed, we will first describe the different breeds and then briefly consider their selection, care, and feeding. In our descriptions we give what constitutes the best type of hog, and immediately after enumerating the desirable points, indicate those objectionable features which are most frequently met with.

POLAND-CHINA.

Description.

1. **Head and Face.**—Head short and wide; jaws broad. Face short, smooth, and wide between the eyes; tapering from eyes to point of nose and very slightly dished.

Objections.—Head long, narrow, and coarse. Face long, straight, and narrow between the eyes; nose coarse.

crooked, or dished as much as a Berkshire; lower jaw extending beyond upper.

2. Eyes.—Large, prominent, bright, and free from wrinkles or fat surrounding them.

Objections.—Small, dull, bloodshot, shrunken, and vision impaired by wrinkles, fat, and other causes.

3. Ears.—Small, thin, soft, and attached to the head by a short and small knuck; tips pointing forward and slightly outward and the forward half drooping, but fully under the control of the animal; both of the same position, size, and shape.

Objections.—Straight, stiff, coarse, large; long or large knuck; drooping close to face, swinging and flabby; difference in form, size, and position.

4. Neck. —Wide, deep, short, and arched from poll to shoulder.

Objections.—Long and slender.

5. Jowl. —Full, smooth, firm, and carrying fullness back to shoulder and so low that lower line will be on a line with the breastbone when the head is carried level.

Objections.—Thin, flabby, or deeply wrinkled.

7. Chest.—Large, wide, and deep, indicating plenty or room for vital organs; showing a large girth just back of the shoulders; not less than six inches between the legs of full grown hog; breastbone extending a little in front of legs and on a line with the belly.

Objections.—Flat or narrow at either end of breastbone.

8. Back and Loin.—Broad, straight or slightly arched, carrying the same width from shoulder to ham; free from creases, that is, surface smooth; shorter than lower belly line; same width as shoulders and hams.

Objections.—Narrow, creased back of shoulders showing deficiency in "heart" girth; swayed or humped; width at side not as great as at shoulder or hams.

9. Sides and Ribs.—Sides full, smooth, firm, and deep, carrying size evenly to lower belly and between

shoulder and ham. Ribs strong and well sprung at top and bottom giving the animal a square outline.

Objections.—Flat, thin, flabby, and not as full at bottom as top; drawn in at shoulder so as to produce crease or tucked up in flank.

10. Belly and Flank.—Wide, straight, and full and dropping as low at flanks as at chest; flanks full and out even with surrounding portions of body.

Objections.—Belly narrow or flabby. Flanks thin or tucked up.

11. Hams and Rump.—Hams broad, deep, and full; should be as broad at point of hips as at swell of the ham. Buttocks large and full, and coming well down to point of hocks. Stifle well covered with flesh, making front and lower part of ham full. Rump should have a rounding slope from loin to root of tail; same width as back and filled out well around the tail.

Objections.—Hams narrow and not reaching down to hocks; lacking in width and plumpness at top or bottom; straight from root of tail to hock. Rump narrow, steep and peaked at root of tail.

12. Legs and Feet.—Legs rather short, straight, and set well apart and squarely under the body; wide apart above the knee and hock and well muscled; below knee and hock hard and smooth; pasterns short and nearly upright. Feet tough, short, firm, and free from any defect.

Objections.—Legs long, slim, coarse, or crooked; pasterns long and oblique showing weakness. Feet spreading, long, and weak.

13. Tail.—Well set on, smooth and tapering, and carried in a curl.

Objections.—Coarse, long, and hanging straight.

14. Coat.—Fine, straight, and smooth.

Objections.—Bristles coarse, wavy or curly, standing up, ends of hair brown.

15. Color.—Black with white on face or lower jaw. White on feet and tail tip, and a few clear small white spots on body not objectionable.

16. Size.—Boars two years old and over, if in good flesh, should weigh not less than 450 lbs. Sows same age and condition not less than 400 lbs. Boars eighteen months old in same condition 350 lbs. Sows same condition and age not less than 325 lbs. Boars twelve months not less than 275 lbs. and sows not less tvan 250 or 275 lbs.

Objections.—Too small or coarse, long, lank or hard to fatten.

17. Action and Style.—Action quick, vigorous, and graceful. Style attractive with high carriage. In male testicles of same and medium size and showing plainly.

Objections.—Slow, clumsy, difficulty in getting up when down; low carriage and wabbling gait. In males testicles not easily seen, too large, or of uneven size.

18. Condition.—Skin clear of scurf, scales, or sores; free from lumps or wrinkles; hair soft and in good condition.

Objections.—Unhealthy, skin scaly, wrinkled or harsh; flesh flabby or too fat for breeding; poor feeders; deafness partial or total.

19. Disposition.—Quiet, gentle, and easily handled.

Objections.—Cross, vicious, restless, or wild.

Disqualifications.—Form; upright ears, small chest and crease back of sholders, deformed or badly crooked legs, feet broken down so they will not support weight of animal. **Size.**—Not two-thirds proper size for age. **Condition.**—Excessive fatness, barrenness, or total blindness.

BERKSHIRES.

In describing what constitutes the proper and objectionable forms of this breed we mention only those points in which they differ from the Poland-China, as on all other particulars the same description will fit both breeds.

1. Face.—Well dished.

Objections.—Straight.

3. Ears.—Erect and of medium size.

Objections.—Drooping and too large or too small.

15. Color.—Black with six white points; that is, white on face, feet, and tip of tail. Some do not object to a splash of white on the arm.

Objections.—Solid black; black points or white spots on body.

Disqualifications.—Very large and heavy or drooping ears. Other disqualifications same as for Poland-China.

DUROC-JERSEYS.

Description.—The general description as given for the Poland-China will apply to the Duroc-Jersey, except where differences are noted.

1. **Head and Face.**—Face nicely dished, about medium between Berkshire and Poland-China.

Objections.—Face too straight or too much dished.

3. **Ears**—Medium size, moderately thin, pointing downward, forward, and slightly outward making a slight curve.

Objections.—Very large, too thick, swinging and flabby, not the same in size and position, and not under the control of the animal.

15. **Color.**—Cherry red without other admixtures.

Objections.—Very dark red or nearly a brown shade, very pale or light red, pale spots over the body, black flecks on belly and legs not desirable.

Disqualifications.—Ears standing erect, and others same as Poland-China.

CHESTER-WHITES.

Description same as for Poland-China except where differences are noted.

3. **Ears.**—Medium size, not too thick, attached to head so as not to look clumsy, pointing forward and slightly drooping.

Objections.—Large, coarse, upright, or drooping too close to the face and not under the control of the animal.

15. **Color.**—White; blue or black spots not desirable, but admissible.

Objections.—Any color but white.

Disqualifications.—Upright ears and those given for Poland-China.

SCORE CARD.

The score card is being used more every day in the judging of swine, and is certainly a great aid in forming a comprehensive judgment as to the respective merits of animals. We have already given what is generally accepted as a description of an *ideal* hog. On the score card each of

the nineteen parts we have mentioned is given a numerical value according to what the best judges consider its relative importance. The total number of points given is 100, and by this standard all hogs are judged. We give it here more especially to show the relative importance attached to the different parts of a hog by the National Association of Expert Judges of Swine.

Scale of Points.	Values.	Scale of Points.	Values.
1. Head and Face	4	11. Ham and Rump	10
2. Eyes	2	12. Feet and Legs	10
3. Ears	2	13. Tail	1
4. Neck	2	14. Coat	2
5. Jowl	2	15. Color	2
6. Shouldears	6	16. Size	5
7. Chest	12	17. Action and Style	4
8. Back and Loin	15	18. Condition	4
9. Sides and Ribs	8	19. Disposition	3
10. Belly and Flank	6		
Total			100

SELECTION OF BREEDING STOCK.

It has always been the case that many people pay insufficient attention to the selection of their breeding hogs. This applies to those who are breeding thoroughbreds to sell as breeders, as well as to those who are breeding for meat production only. The end of *hog* is *pork* and no hog is too good for even the small farmer who produces merely enough meat for home consumption. Of course there will always appear animals of such outstanding individual merit as to keep them from the butcher's block, but that is no reason why stunted thoroughbreds and other scrubs need be considered "good enough for meat hogs."

The long legged, lank, and thoroughbred or grade is not the most profitable hog for the purpose for which a hog is intended, viz., the production of pork; and if the farmer will but count the cost of making a given amount of pork from this sort of an animal he will readily see that the increased cost will more than balance any difference which existed in the original cost of the breeding stock. Good thoroughbreds are neither too good nor too expensive for "meat hogs." This must be apparent, for the only use to which a hog can be put is to produce pork, therefore if the thoroughbred has any superiority over the razor-back it must be in his greater value for feeding purposes. A good pig at five dollars when two months old is cheaper for feeding purposes than is a scrub costing nothing, and any man can fully demonstrate the fact by counting the cost of feed in relation to their respective values at slaughtering time.

The idea that "anything is good enough for a meat hog" is costing farmers thousands of dollars annually.

The first thing to be done is to select some one of the improved breeds. It is not very important which, and our ticket is "anything to beat the scrub." Having selected the breed we desire to raise, the next thing is to secure good representatives of that breed. There are two things to be considered in selecting an animal for breeding purposes. First, pedigree; and Second, individual merit. It is generally thought that the time which the farmer would spend studying the pedigrees of a breed of hogs would be lost, but no greater mistake could be make. Certain families in all breeds have become fashionable because they have shown superior qualities, and it is evident that, other things being equal, the animal whose ancestors have shown excellence will be most likely to produce progeny of excellence. Therefore any person who is going to put money into any breed of hogs should know enough about the families of that breed to select those most likely to produce good offspring. To select an animal of high individual merit requires a knowledge of what constitutes the best type of the breed. This knowledge can only be obtained by study, and inspecting good specimens. Because one has a better hog and a finer looking animal than a razor-back is no proof whatever that it is not a scrub. There are a number of men in Mississippi who offer for sale what they claim to be the best strains of the different breeds, who do not know the strains of their respective breeds. In honest ignorance many of them are inflicting on their equally ignorant customers animals just a little removed from the razor-back. This is due to the fact that they have bought their stock from persons who, like themselves, had never seen the best of the breed, or from breeders who, against their own interest and the dictates of their consciences, sold them their "culls" because they were not willing to pay more than "cull" prices. Many people place too small value on quality in a hog; with them one hog is as good as another, and so long as he is a thoroughbred and eligible to registration, they are satisfied. Scrubs of the thoroughbred class are numerous, and therefore an animal must be something more than a thoroughbred. He is worth a good price and will bring it. Most people in Mississippi think $10.00 a big price for a boar pig three or four months old, when in truth if he is good enough to save as a breeder he is worth many times that in one year to almost any

farmer. One noted Berkshire breeder in Missouri sold nearly 200 head in 1894 at an average of $45.00 each. Still I have known men to send him $25.00 with the request that he send them in exchange a "first class pig," and when they failed to get such were disappointed. Is it reasonable to suppose a man will sell a first class pig for about half the price he gets for his *average*.

If the prospective purchaser has had sufficient experience to know what constitutes a first class animal, and can make the purchase after a personal inspection of the stock, he may find some young and unknown breeder who will sell him a first class animal in breeding and quality for from $12.50 to $25.00; but if he has not had this requiste experience, or must buy by mail order, then the only safe plan is to buy of some well known breeder and pay a good price, say from $25.00 to $50.00 At present a great many in the South are sending North for first class pigs, but owing to the fact that they are not willing to pay first class prices, are getting scrubs at scrub prices. Our state is serving as a "dumping ground" for inferior animals of the northern breeders because we are unwilling to pay the prices that good animals will command. An inferior animal is too dear for breeding purposes at any price, while a good one is cheap at any reasonable figure. From $25.00 to $50,00 is considered a price beyond the reach of ordinary farmers. This is true to a certain extent, but any neighborhood will furnish five men who can afford to pay $10.00 each for a boar, and one boar will do the work required by five average farmers. One boar will be able to get at least 100 pigs each year. If these pigs are worth 50 cents more each at killing time than those from the scrub now in use. he has paid for himself the first year. This is a plain statement, and yet few will act upon it. The truth is that these pigs will be worth from $2.00 to $10.00 more at killing time, and will have consumed less food.

The Type of Boar to be Selected.—A pig less than four or five months should not be selected, as before that age it is impossible to form a sufficiently accurate opinion as to his future development. The breeding boar should be of medium size, smooth build, straight strong legs, short neck, and heavy compact body. Particular attention should be paid to the quality rather than the size. The shoulders should not be the largest part of the body, because not the most valuable. Proceeding from the head to

the hams the meat gradually increases in value, hence the hams should be large in proportion to the rest of the body. The side that fits a straight-edge from shoulder to ham, and a back that is broad and straight, belong to the type of hog we want. At six months he should weigh 150 lbs. and at one year 300 lbs. and this is not too fat for breeding purposes. He should be active but not restless, and vigorous but not vicious.

The coarse, long legged, and long bodied hog so much sought for by many, is not a profitable breeder, no matter how long bodied he may be, nor how much he may weigh when a year and a half old. The compact type shows great superiority in converting a given amount of feed into pork, and especially should all coarseness be avoided in a boar. He should be selected from a large litter, say of not less than eight of even quality, for his progeny is likely to be near the average of the litter he is from. His mother should be a mature sow, and of tested qualities as a brood sow and suckler. This test is important, as to have good pigs they must get plenty of milk when young.

The Type of Brood Sow to be Selected.—The boood sow may be of a little larger and coarser type than the boar if she possess the other requisite qualifications. By all means should the "dumpy" or "China" build be avoided, but this does not mean that the other extreme is any less objectionable. In short she should be of a compact, firm build but should possess size enough to be able to carry and support a good large litter of pigs. To be a good brood sow means that she is a good suckler. The milking quality runs in strains in sows, as in cows, and no sow should be selected to breed from that is not of a deep milking family. Her disposition should be of the best, as it may enable one to save many a pig that an irritable sow would kill. She should be one of a litter of not less than eight, and from a mature sire and dam. An animal that is in any way defective or delicate should be excluded from the breeding herd, and in a sow especially is vigorous health and a good appetite necessary. With a litter of eight to ten pigs to feeds her digestive powers will be taxed to the utmost, if the pig, are not to suffer.

CARE OF THE BOAR.

In another place we shall discuss the feeding of breeding stock, therefore in this connection we shall merely consider the care of the boar from pighood up to maturity and

during the time he is kept from service. At about four or five months old he should be separated from any females that are likely to come in heat. By all means keep the boar in a lot by himself. He should no more be allowed to run with the sows than a stallion with mares. It is not too great an expense to do this, but on the other hand, it is the greatest economy. It will save feed for both sows and boar, if kept free from the excitement that always occur when they run together, and they will keep in better condition on much less food. It pays because the boar can be kept in better condition and will therefore get more and better pigs. Again if the sow is put with the boar to be bred, the exact time of farrowing can be calculated, the sows watched and more of the pigs saved. It is better for both sow and boar to permit only one service instead of allowing them to run together for two or three days and nights. The sow will have more and better pigs, and the boar will keep in better condition for service. At four months the boar should be put in a lot of not less than a quarter of an acre. The fence should be such as to preclude the possibility of his getting out, for on this depends the ease with which he can be kept in after life. Every time he gets out it will require a better fence to confine him afterwards. Keeping in too close a lot is almost as bad as allowing him to run with the sows. He does not get sufficient exercise to keep his muscles in good condition, and the result is he becomes inactive, lazy, and a bad performer. By all means keep the boar pig from any sows until he is at least eight, and if possible, until he is ten months old. I know it is useless to advise the average man to keep a choice boar until he is eight months old before using him but it would pay him to do so. If used too young he becomes restless and does not grow well, and his development and future usefulness are thereby impaired. A matured boar in vigorous health will get much better pigs than can be hoped for from an immature pig. His lot should contain shade, and an open shed or trees will serve the purpose. In winter a comfortable house should be provided. One eight feet square with a good roof, and closed on three sides, the south side being left open, will serve the purpose well. Unless the ground is exceptionally well drained, and great care be taken to keep it free from dust, a plank floor is best. The animal heat of the body is kept up by the burning of the food eaten, therefore if the hogs

are not sheltered more food is required. It costs less to keep a hog warm with lumber than with corn, and it will pay to shelter him. He needs but little shelter in winter, but needs that little very much. If this sort of treatment is too expensive, then no man can afford to keep a boar, because experience proves it to be the cheapest method. One boar may be kept in a neighborhood in this manner at a trifling expense to each of a dozen men, and if such a co-operative system could be practiced by our farmers a first class boar will pay for himself in one season, even though he cost what seems the large price of $50.00.

MANAGEMENT OF THE BROOD SOW.

When four months old she should not be associated with uncastrated males. She should not be bred until she is at least one year old. This is important, for no young sow can suckle a litter of pigs and grow at the same time. Let her get her growth before her constitution is taxed with the suckling of a litter of pigs. If, as is customary, she is starved and only about half the size she ought to be at ten months old, and is then forced to raise a litter of five or six pigs, we cannot expect her to do the pigs justice, nor to develop into the square even bodied specimen we so much admire. A mature sow in good condition will raise a litter of pigs, five or six in number, that will be worth more to feed or breed than two large litters from a young, lean, half starved sow. Therefore do not ask her to suckle a litter until she is at least sixteen months old. When bred she should be kept growing right up to farrowing time. During the first two months she may be fed liberally, if given food of a bone and muscle making kind. During the next two months she should be kept growing a little, but not pushed. During the whole time, or at least up to within a week of farrowing, she should be allowed to run in pasture, or a large lot. A week before she is due to farrow, which will be about 106 days after breeding—for the period of gestation in a sow is from 113 to 116 days—she should be placed in a small lot, in which is the farrowing pen. She should be alone and disturbed as little as possible. During this week the food should be small in quantity, and of such a nature as to keep the bowels loose. In Mississippi it is a common practice to allow the boars to run with the sows, and the breeder therefore does not know when his sows will farrow. He allows them to run with other hogs and furnishes them no special place to farrow. Then when the

pigs are killed by other hogs, laid upon by the mother, or smothered in an improper nest, he bewails his hard luck(?) and the unprofitableness of hog raising. His bad luck, as usual, is bad management, the result of laziness or ignorance. If it pays to keep a sow to raise pigs, it certainly does not pay to let those pigs die, when a little attention might save them. As before stated the sow should be put in a small lot—in which is a farrowing pen—about a week before farrowing. This pen should be about ten feet square and closed to make it comfortable in winter, and open for the same reason in summer. Running around the sides of the building about six inches above the floor and parallel with it, a plank about ten inches wide should be spiked. This will give the piggies a place of safety where the mother can neither crush nor smother them. This alone will save enough pigs to pay for the whole house, or pen. In winter a little short or fine bedding may be allowed, but in summer the bare floor or ground is preferable. Many a man, out of kindness, gives his sow a large bed, thereby furnishing her means of smothering the young. If the sow is worth keeping she is worth watching at farrowing time. A man who for any reason is not in actual attendance when the sow is farrowing, should not have the care of stock, as many a pig may be saved by a little care at this time. If it is very cold the pigs should be taken from the sow and placed in a basket filled with rags, or something similar, to keep them warm. Shortly after the pigs are all born, they should be put back with their mother. I am aware that most farmers consider this too much trouble, and I agree that this time would not be well spent in the caring for razor backs, but if one has hogs worth feeding, he should give them such attendance, as the loss of a litter of pigs is the loss of considerable money. We are, in the South, not sufficiently accustomed to looking after the details to make stock raising successful, for the successful raising of stock, above all other things, require close personal attention to the details of management and feeding. For the first three weeks after farrowing the sow should be confined to the lot. During the first week she should receive little more than enough to sustain her, and nothing should be fed that is calculated to produce a large flow of milk. From the end of the first week to the end of the third week the food should be gradually increased, and from the time the pigs are four months old until they are weaned the sow should get all the milk producing food she will eat. If the feed

has been gradually increased she will not lose her appetite, as so often happens. It requires more care than skill in feeding the brood sow. It is important that the milk supply be increased in proportion to the increased capacity of the pigs to consume it. If the sow be fed too much when the pigs are young, too much milk is taken by them and "scours" or diarrhœa is the result, while if not enough is given, when the pigs become older they fail to grow as they should, and it must be remembered that it is extremely doubtful whether any pig that is stunted in its growth when young ever pays for its feed. The feed for the brood sow at first may consist of house slops, and a little dry grain, but not later than the tenth day we must begin to feed for the production of that milk supply needed to sustain the proper growth of the litter. The feed to be given is skimmed milk, wheat bran, or shorts, ground wheat, oats, or peas, and some green fodder, preferably red clover or alfalfa. She should be fed three times a day, and allowed all the fresh water she can drink. After four weeks she and her litter should have the run of a good pasture.

No attempt should be made to breed her until after the pigs are weaned. This should be done when they are about two months old, and the sow will almost invariably take the boar inside of a week. This enables her to produce two litters in a year which can be done to the best advantage in this climate.

CARE OF THE PIGS.

During the first three days of the pig's life he requires close attendance. A failure to give this attention usually results in the death of one or more of the youngsters. If the board be put in the pen as before described to protect them, and not much bedding, and that of a short fine material be allowed the sow, little danger from "overlying" or smothering need be anticipated. The sow and pigs should be disturbed as little as possible for the first few days, but sufficient attention should be given them to see that all the pigs suck, and if the stock is to be sold for breeding purposes it will often be necessary to treat the tails of the young pigs to keep them from falling off. It is generally thought that this falling off of the tails is due to cold and dampness. This is not so, as they suffer in the dryest September just the same. It is a disease, but one easily combatted. We have found washing the tails in a strong solution of Boro-glyceride most effectual, but any grease, es-

pecially if it has mixed with it a little carbolic acid, will do the work. The application should be made once a day for the first three or four days.

During the first few days the pigs should be confined to the farrowing pen, or at most, allowed to run in a small dry lot. They will do better to be confined to the lot until they are at least three weeks old. Just as soon as the pig shows a disposition to eat he should be encouraged in so doing. A small place should be cut off from the lot so as to allow the pigs, but not the mother, to enter, and in this little lot should be a shallow feed trough. If the pigs are getting plenty of milk from the mother, as they will provided she is a good brood sow and is well fed, there is nothing better than soaked corn. Dry hard corn will soon make their teeth sore. An abundance of this soaked corn should be provided, but what is left should be removed at least twice a day and fresh corn put in. If a little sweet skim milk can be given with care, we think it will add to the growth of the pigs. This may be continued until weaning time, when a decided change in the feed becomes necessary. This is the most critical period of the pig's life, and on his management at this time largely depends his future usefulness. If checked in his growth he will probably not recover soon enough to give the best results whether kept to grace(?) the breeding herd or to fill the pork barrel.

It takes a genius to manage a pig properly at this time without milk. It certainly requires great care and a variety of good foods at least. With ground oats and shorts, or wheat, and clover or alfalfa, judiciously but freely fed, good results may be obtained, bnt it will be found much easier to grow good pigs if plenty of milk is obtainable. Here in Mississippi we can have red clover or alfalfa or some similar green food for our pigs, and with this, corn meal and skim milk mixed makes an excellent food. They should be given this in abundance. It is a mistake to suppose that a pig will get too fat on this sort of food. We must feed well if we are to get early maturity, and the most profitable results. It is not wise to feed too many pigs together, not more than ten, and then only when these are about the same size and age, and when the trough is so constructed that any may eat without much interference from others. The Wood Dale cast iron pig trough, out of which eight can eat, is the best thing we have ever used in the shape of a trough. These troughs are easy to keep

clean, and whatever the sort of trough used it should be kept clean and sweet.

THE FEEDING OF BREEDING ANIMALS.

Early maturity is the result of freedom from hardships, and an abundance of nutritious food. The aim of the breeder has been to produce a hog that would mature at the earliest possible period of his life, and by careful attention to selection, care, and feeding much has been accomplished in that direction. To perpetuate this quality much care and food are necessary. Without, these acquired characters are easily lost and the animal quickly reverts to his original condition. Nature has made it possible for our southern domesticated animals to procure a good share of their food from their pastures during the whole year; hence, we do not pay as much attention to feeding as we should to obtain the best results. The animal that is to be kept for breeding purposes should receive an abundance of food of the proper character until it reaches maturity at least.

There is an idea prevalent that the gilts must not be fed well, or they may become too fat for breeding purposes. The most noted breeders in America almost universally agree that if fed on the right sort of food there is absolutely no danger of any sow under a year old becoming too fat. If we desire good growth, fine size, and early maturity the breeding stock must be fed liberally, not only before one year old but after. A sow when in good condition, even what many Mississippians consider too fat, will bring stronger and better pigs, and suckle them much better than when thin. It is barely possible that she may not have as many pigs at a litter, but this is extremely doubtful, and it is certain that she will have a litter of pigs worth much more money. The same may be said of the boar. He will get better pigs when kept in good condition than when poor. This is not all, for if one is breeding pigs to sell to breeders, a litter from a boar and a sow that are too "fat" as the people say, will sell for double what the same number, from the same sire and dam, will when thin. No kind of stock will sell when in poor flesh. No person looks more than once at a thin animal, but all will stop to admire a slick, plump, and well rounded form. This is universal, it matters not whether the person be a novice, or a veteran breeder. It therefore not only pays to feed well, it is doubtful if hog raising can be made profitable with but liberal feeding. It will always pay to feed the pig all it can eat.

and the pig that will eat the most is the one that will pay the best. What the breeding stock should be fed, is then the important question. This must be answered by each breeder according as his facilities for procuring different feeds may vary. One thing is certain, however, and that is that a variety is essential, and in facilities for furnishing this is just where the South excells as a hog raising country. Hog raisers estimate the value of a pasture at from 25 to 75 per cent of the food supply, but by a pasture they mean a good one. In Mississippi a pasture may be furnished the whole year, by careful management. During the summer and fall red clover and alfalfa will furnish the best food. For early winter, alfalfa and barley will fill the need, and for midwinter rye is perhaps the best, while for late winter and early spring vetch and alfalfa will serve admirably. During the wet weather of winter, pasturing may be impracticable owing to the injury which will result to the land. This objection does not hold when the land is sandy. A great many have come to regard corn as the legitimate hog food, and too many regard it as the only available grain food. With the pasture above described, fairly good results may be obtained by merely the addition of a corn ration, but the mistake of requiring the hogs to live on the pasture alone should not be made, nor should corn be the the only food. For mature breeding stock, except sows suckling pigs, the pasture, if good, and corn will suffice, but for pigs and for milking sows something more is needed. This additional food should be of the bone and muscle forming sort, and may consist of skim milk and ground peas, oats, or wheat. Wheat bran and shorts are excellent, but are usually too expensive to render them available in the South. One thing is certain, if we are to raise good hogs that will pay the best profits, we cannot depend on "Nature" unaided to furnish the entire food supply. No matter how good the "mast," nor how luxuriant the pasture, the hog that is fed some grain ration in addition, will pay the best profits. The brood sow and young pigs especially should receive something more than corn and pasture to do the best. Of those foods one or two of which should be added, may be mentioned skimmed milk, peas, oats, wheat, wheat bran, shorts, etc. The grains should be ground and mixed either with milk or water. In the South, we believe that alfalfa or red clover for pasture and skimmed milk and corn, or peas and corn, the most available foods for the brood sows and young pigs. For all other an-

imals there may be some doubt as to the economy of grinding the grain ration, but for the young pigs from two to three months old there can be no question as to its advisability. In fact it would pay every farmer who feeds a few hundred bushels of corn annually to buy a mill and grind corn, cobs, and shucks all together, by horse power, if no other power was available.

PORK PRODUCTION.

The South is still paying immense sums annually for northern ham, bacon, and lard; but the time is not far distant when this condition of affairs will no longer exist. There is ne good reason why a country so admirably adapted to hog raising should not, at least, produce its own pork supply; this is likely to remain a difficult task for Mississippi until packing and cold storage establishments become more numerous. While it is not our purpose to discuss that question here, it may be confidently asserted that their establishment quickly follows the growing of good hogs in any considerable numbers.

The hog that can be fed to the best advantage at present in this State is one farrowed in early March and slaughtered the following December or early part of January. At ten months old he should weigh at least 300 pounds gross, which is as large a hog as can be most profitably grown. In this way the two months, January and February, during which the keep of hogs cost the most, may be avoided. However, with our mild climate and facilities for producing green feed any month of the year, fall litters of pigs may be made profitable.

Under the system now in vogue a pig ten months old will not weigh more than from 100 to 150 pounds, but this is not the most profitable system of pork production. A compact, small boned, early maturing hog that will eat and digest the largest amount of food in the shortest length of time will usually make the greatest number of pounds of pork at the least expense. Therefore for the production of pork the greatest needs of the South are better hogs and better feeding. A hog that has "lived on the range" until he is two years old and is then fed a few bushels of corn before being slaughtered may be a profitable hog, but he is not the most profitable. The agricultural sensationalist may talk of producing pork at one-half cent per pound and on the same basis—counting nothing for land and maintenace of

breeding stock—pork may be produced for nothing; but if five dollars worth of feed produces a fifteen dollar hog the profit is greater than on the seven dollar hog that costs nothing. Our aim should be to secure a quicker return on money by a more liberal system of feeding.

When at four or five months old the "pork hogs" are separated from those that are retained for breeding stock, a difference in the feeding of the two lots may be made. From four to eight months old the pig should be allowed a moderate corn ration and an abundance of such green foods as red clover, alfalfa, grasses, peanuts, sorghum, etc. During the last two months, in addition to this green feed, he should be allowed all the corn that he will eat.

CHOLERA.

Hog cholera is reported as prevalent in many sections of the South. Much of the disease reported is probably not true cholera, but its nature is such as to require much the same preventive measures. In the first place we wish to state that there is positively no known cure for hog cholera. The man who buys cholera cures(?), and neglects the hygiene of the hog lot, is burning hard earned money on the altar of his ignorance. After the disease once appears, medicine at best can only be of palliative value. It is safer, cheaper, and better to take such care of the hogs as to render the introduction of cholera improbable. See to it that not more than twenty-five hogs are allowed to run in a bunch; avoid dusty sleeping quarters, and by all means keep them free from the characteristic southern hog pool. It is no wonder that a mud-hole that has been polluted with animal excretions for years should serve as an excellent medium for the development of disease-producing germs, These wallows which many people deem so essential to the existence of the hog in hot weather are his worst enemies. In warm weather reasonably clear water for the hog to go into is good (a bath is good for any animal), but if he has good shade, and plenty of pure water to drink, he can very well dispense with the water to lie in.

Be sure that the hogs have a variety of food, and sufficient of it to keep them in good condition. Hogs that depend on a scant supply of corn alone, or are compelled to get their whole living from a poor pasture, are in no condition to resist the introduction of a disease. Give the hogs green food, but along with it corn or other grain.

Keep in the pig lots, but under shelter, some such mixture as the following:

Charcoal	1 bushel
Slaked lime	2 quarts
Hardwood ashes	1 peck
Salt	1 quart

Break the charcoal up into small pieces with a shovel and mix thoroughly. The hogs like it and it helps to keep their digestive organs in good condition.

At least once a week wash and disinfect all feed troughs, and sprinkle all low or filthy places in the lot with plenty of lime or a solution of carbolic acid—one part of the crude acid to twenty of water. Do not permit the mingling of other hogs with yours, until they have been quarantined for at least thirty days. If cholera is in the neighborhood do not permit any person to visit your lot who is not known to be from an uninfected place. Keep the bowels open with feed or suitable medicine. If medicine is used Glauber salt is perhaps the best. It is also a good practice when there is danger of infection to give, in slops, ten drops of carbolic acid and twenty grains of copperas once or twice a day to each 150 pounds of hog. In case cholera breaks out in the herd, remove the well ones, not the sick, to another lot—preferrably to higher ground. If others become sick, again remove the well ones to new quarters. A temporary fence can be built at little cost, and may be the means of saving several hogs.

Burn all the dead animals, and thoroughly disinfect the places, as advised above. Treatment of the diseased hogs with any or all of the so-called "sure cures" is useless and dangerous. The longer they live the greater the danger to the rest of the herd

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 36.

INSECTS INJURIOUS TO CORN.

HOWARD EVARTS WEED.

AGRICULTURAL COLLEGE, MISS.

NOVEMBER, 1895.

The bulletins of the Station are sent free of charge to all farmers in Mississippi who apply for them.

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INSECTS INJURIOUS TO CORN.

INTRODUCTION.

In the following pages no attempt has been made to form a complete list of all the species of insects which attack corn, but mention is made of those which are more commonly injurious in this State with a view to the use of the bulletin for reference when any insect is found attacking corn. If any species which are not mentioned in this connection are found at any time doing damage, farmers are invited to send specimens to the Station for determination. Corn is subject to the attack of many insects and for most of these we have good preventive measures whereby the damage caused by them can be greatly lessened, though for a few we lack good remedies or preventive measures. The methods recommended in these pages, however, will do much to lessen the damage by corn insects.

INSECTS INJURIOUS TO STORED CORN.

This subject has been fully discussed in a former bulletin (Bulletin No. 17 "Insects Injurious to Stored Grain") which will be sent upon request, so that the subject need not be entered into in detail here. The principal insect doing damage to stored corn is the black weevil (*Calandra oryza* Linn.) shown in Fig. 1. The remedy for insects in all kinds of stored grain consists in pouring bisulphide of carbon over the top of the grain, and the reader is referred to Bulletin 17 for further details.

Fig. 1.—The Black Weevil. *a*, larva; *b*, pupa; *c*, adult. (Original.)

THE CHINCH BUG.

(*Blissus leucopterus* Say.)

This insect does immense damage in some of the states of the northern Mississippi valley, but in this State has never caused much damage. Reports are received of its damage in several corn fields nearly every spring, but upon investigation only a few of the bugs are generally found. The species is most common in the western portion of the state along the Mississippi River. In the fields of the Experiment Station the insect is found in small numbers every year, but it is never abundant enough to do any damage. Its mere presence in a field need in no case cause alarm, nor need this be the case unless the insect occurs in such large numbers as to make the plants in an infested field appear black owing to the numbers of the insect.

Fig. 2. ADULT CHINCH BUG Enlarged. (After Riley.)

As most of the farmers of this State are doubtless unfamiliar with the chinch bug, the following brief description is given to aid in its recognition. The mature insect is about one-fifth of an inch in length, having a black body, and light colored wings with two black spots upon them as shown enlarged in Fig. 2., the natural length being shown by the line at the bottom. The young differ from this in being smaller, without wings, and of a reddish color, the eggs and young stages being shown in Fig. 3 The chinch bug causes damage to the plant by sucking the plant juices and plants attacked present much the same appearance as that caused by drought.

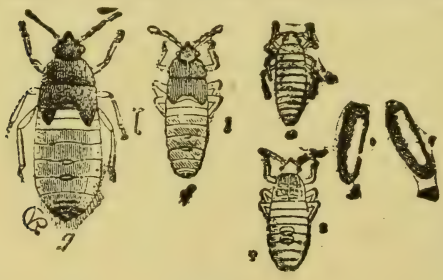

Fig. 3.
Various stages of growth of Chinch Bug. *a*, *b*, eggs; *c*, *e*, *f*, young; *g*, pupa or nymph. (After Riley.)

REMEDIES.

Where the chinch bug occurs in but small numbers, as

is generally the case in this State, no special attention need be given the crop other than thorough and frequent cultivation. A frequent stirring of the soil will both retain the moisture for plant food, thus better enabling the plants to withstand insect attack; and will be the means of killing many of the chinch bugs, especially the young larvæ.

A method of checking the increase of this pest which has recently been the subject of much experimentation, particularly in Kansas and Illinois, consists of spreading throughout infested fields bugs either dead or dying from the effects of a contagious disease. The manner in which this is accomplished briefly stated is this: A large quantity of fresh bugs are gathered from an infested field and put in a vial containing a few diseased bugs and in a few days the disease will spread so, that all the bugs in the vial are affected. These are now scattered in various parts of an infested field, a few of the diseased bugs being retained for future infection, and in a week or ten days the bugs in the field will take the disease and die in large numbers.

Fig. 4.
CHINCH BUG Affected with Disease. Enlarged. (After Lugger.)

There seems to be no doubt but that this method of checking the increase of the chinch bug is very effectual when two conditions for success are present. These are (1) a large number of chinch bugs in the field and (2) a moist condition of the atmosphere. Unless there are a large number of bugs in the field, the disease does not spread well and it would be useless to try this remedy under such conditions. The state of the weather will also largely affect the spread of the disease in the field, wet weather favoring the spread of the disease and dry weather retarding it. During wet weather the bugs will some times be killed off by disease, even though no attempt has been made to introduce it. Diseased bugs on corn and an enlarged bug dead from disease are shown in Fig. 4.

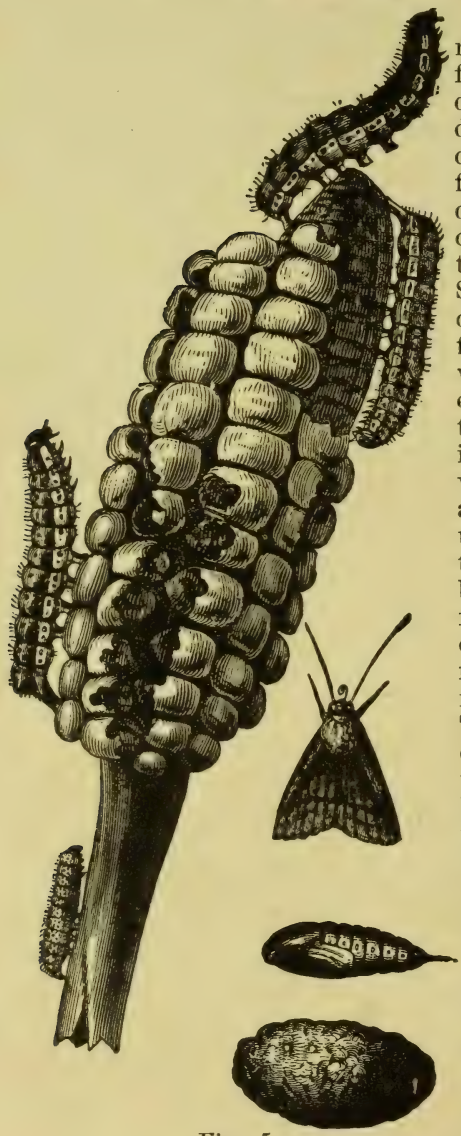

Fig. 5.

CORN WORM at work, showing larvæ, pupa, pupa case, and moth. (After Riley.)

In June 1891 several reports were received from Mayersville, Issaquena County, of great damage being done by chinch bugs in several fields in that locality. A quantity of diseased chinch bugs were obtained from Dr. F. H. Snow of the University of Kansas, and several fields at Mayersville were personally infected with them. Although the bugs were plentiful in several fields they were not as numerous as the reports has led us to believe. Some time after the diseased bugs were put out, the reports received indicated that the bugs had nearly all disappeared from the infested fields. Thus while the results of this one experiment were favorable, yet the bugs might have disappeared without any artificial infection, and opportunity to experiment further with this method has not since presented itself.

THE CORN WORM.

(*Heliothis armiger* Hbn.)

This insect is known as the corn worm, cotton boll-worm, and tomato worm according to its food plant, damage to the various plants

being caused by one and the same species. As a rule there are five annual broods of this insect, the first brood being on tomatoes and corn, the second and third more commonly on corn, while the fourth and fifth broods are more common on cotton. The species is a very general feeder and, aside from the three plants mentioned, has many other food plants, such as cow-peas, okra, and jimson weed.

The corn worm in its various stages is shown in Figs. 5 and 6, and is so well known as to need no further description. The eggs for the first brood are laid on the outer leaves of young corn. The young larvæ eat holes through the unopened leaves and after these have opened, the holes made by the worms are plainly visible. The later broods work in the ears of corn, the larvæ eating both the growing kernels and the husk. The species passes the winter as a pupa in the ground and the moths appear in April, at which time the eggs for the first brood of worms are laid.

A peculiar and important trait of the corn worm is its cannibalistic habits. Wherever the worms are in confined situations they devour each other with great rapidity so that it is a rare thing to find more than one mature worm on an ear. It is no doubt owing to this habit that the worms do not increase in numbers more largely. Female moths have been found upon dissection to contain over 500 eggs, and at this rate, assuming one-half of the eggs to produce females, a single female in April would represent "a progeny of nearly two trillions of caterpillars (1,953,125,000,000) in its last annual brood in November, a number fourteen times greater than that of the entire human

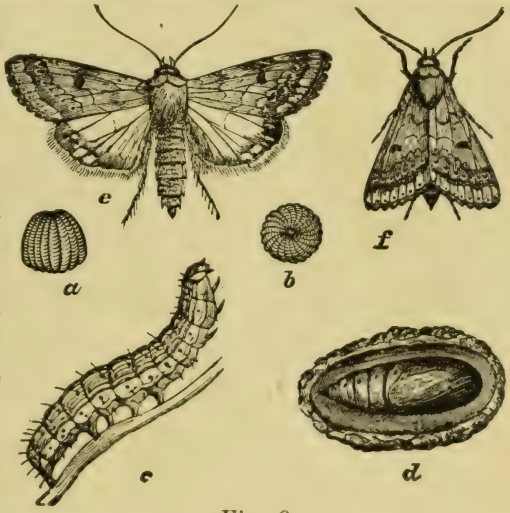

Fig. 6.

CORN WORM. *a* and *b*, eggs; *c*, larva; *d*, pupa; *e* and *f*, moth. (After Riley.)

population (as estimated) of the globe." (Lintner). As the corn worms work in confined places, parasites play but little part in checking their increase, so that the non-increase of their numbers may be properly attributed to their cannibalistic habits.

REMEDIES.

Clean culture and fall plowing of infested lands will do much toward lessening the numbers of this insect, the latter exposing many pupæ upon the surface which will be destroyed during the winter by birds or sudden changes of the weather. A method which is entirely practical consists in crushing the larvæ of the first brood with the hand. An attacked plant is easily noticed and it is the work of but a moment to destroy the larvæ within. Later, also, the second brood of worms can be destroyed in a similar manner when the corn has reached the "roastingear" stage. As each larva of the first or second brood which may be destroyed represents the destruction of many more later in the season, it is important that this work should be carried out.

THE SOUTHERN GRASS WORM.

(*Laphrygma frugiperda* Guen.)

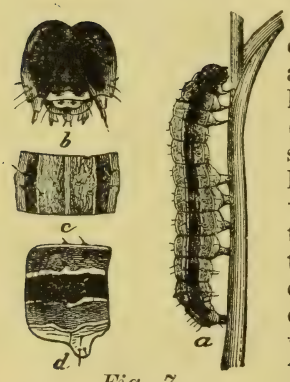

Fig. 7.
SOUTHERN GRASS WORM. *a*, larva; *b* and *c*, side and back of body; *d*, head; *b*, *c* and *d*, enlarged. (After Riley)

This insect is known under a variety of common names, more especially as the "fall army worm." It differs, however, from the true army worm (*Leucania unipuncta* Harv.) and also should not be confused with the cotton leaf-worm (*Aletia argillacea* Hbn.) which is also improperly spoken of as the army worm. In some years the true army worm (*unipuncta*) is very common in the northern and middle states, but it is more rare with us. The southern grass worm, on the other hand, is probably more common with us than in the northern states.

The larva of the southern grass worm is shown in Fig. 7 and the mature insect, a dark colored moth, in

Fig. 8. The full grown larva has a dark colored body with a yellow stripe on each side, and resembles the various cut-worms in general appearance. The larvæ feed upon grass more especially, although corn and all kinds of grain come in for their full share of attack when the insects are abundant. In the southern states there are three broods in a season, and although instances of damage are not rare, yet as a rule, it is only the larvæ of the second and third broods that do any marked damage, and it is on this account that the species has sometimes been called the fall army worm.

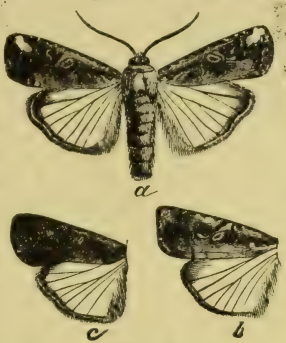

Fig. 8.
SOUTHERN GRASS WORM MOTH, showing variations. (After Riley.)

REMEDIES.

Paris green, either in a dry form or mixed with water, will kill these caterpillars. When it is applied in a dry form it can be mixed advantageously with fifty parts of flour, slaked lime, or road dust, and when applied in the liquid form the proper proportion is one pound of Paris green to 200 gallons of water.

As these caterpillars often occur in a particular field and will go to another as soon as the field field has been eaten nearly clean of any growing grain, it is advantageous to plow a deep furrow around a field which joins an attacked field. The worms will all migrate at about the same time and can be easily killed in the furrow by dragging a log through it.

Prof. Morgan of the Louisiana Station states, "As these caterpillars feed in the cool of the morning and evening, they may be found upon the outer leaves of the corn, and with a stick and a wide mouthed vessel great quantities can be hand picked. Two or three pickings will relieve a field almost entirely, and will be the means of saving the crop."

THE SOUTHERN CORN ROOT WORM.

(*Diabrotica 12–punctata* Oliv.)

This insect is a general feeder, having many food plants other than corn, such as the cucumber, squash, cow pea and others. The larva works upon the stalk and the main roots, and is sometimes known throughout the south

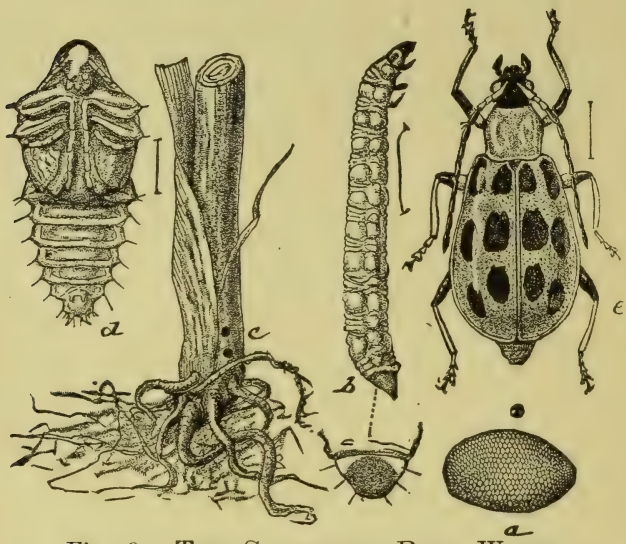

Fig. 9.—THE SOUTHERN ROOT WORM.
a, egg; *b*, larva; *c*, corn stalk, showing punctures; *d*, pupa; *e*, adult; *a*, *b*, *d* and *e*, enlarged. (Insect Life.)

as the "bud worm," and the mature beetles feed also upon the leaves. Fig. 9 illustrates the various stages of this insect. the mature form being a greenish beetle with 12 black spots upon the wing cases. There are two broods in a year with us, the second brood being produced upon the cow pea and several wild plants. The mature beetles live over winter, the eggs for the first brood being laid about the first of May.

REMEDIES.

There is no practical remedy for this insect, but frequent cultivation and stirring the soil about the roots will greatly aid the plants to withstand attack.

CORN BILL-BUGS.

(*Sphenophorus Sp.*)

The natural food plants of these insects are various bulbous grasses within the large roots of which the larva feed. The mature beetles damage young corn by feeding on the young leaves and stalks, and if they are numerous in a field the damage done will amount to considerable, for a single small punc-

Fig. 10.
A CORN BILL BUG. (*Sphenophorus cribrus*). Enlarged. (Insect Life.)

ture in a young plant will damage the plant much more than many punctures later when the plant is stronger.

Fig. 11.
BILL BUG at work in the Club Rush. (Insect Life.)

Although there are several species of these bill-bugs, they all resemble each other very closely. In their mature form they are black beetles about one-fourth inch in length. One of the beetles is shown enlarged in Fig. 10 and the manner in which it works in bulbous grasses in Fig. 11.

REMEDIES.

These insects occur only on low, swampy ground, and in such situations a sharp lookout should be kept for their presence as soon as the corn is fairly well started in growth. As one beetle may damage several plants, where the beetles occur in small numbers, as is generally the case, hand picking will prevent most of the damage. If the beetles occur in very large numbers, which is seldom the case however, spraying with Paris green about the base of the stalks is recommended. A replanting will sometimes be necessary and the second planting will be but little if any attacked. Where sod land is broken up in the fall the beetles will do but little damage the following spring.

CUTWORMS.

(*Family Noctuidæ*)

These caterpillars are the larvæ of night flying moths. There are many species of these, a common one being that known as "the variegated cutworm" (*Peridroma saucia* Hbn.) shown in Fig. 12. The moths lay their eggs during the summer months and the larvæ generally

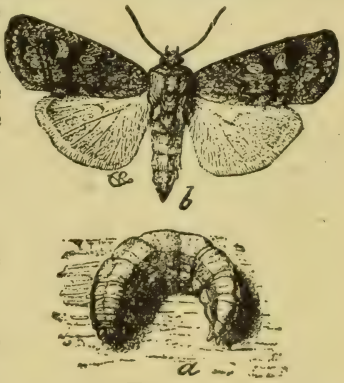

Fig. 12.
THE VARIEGATED CUTWORM. *a*, larva; *b*, moth. (After Riley.)

feed upon grass during the summer and autumn. During winter they secrete themselves in grass, under boards, and the like, and early in the spring are ready to attack any green vegetation. As they are nearly full grown at this season, they need not be very numerous to do considerable damage. Cutworms are most numerous in land which has previously been allowed to become grassy. The young larvæ feed in the grass during the autumn and if the land is not plowed until spring the larvæ will feed upon almost anything which may be planted on this land.

REMEDIES.

In gardens it pays well to trap the worms under boards, or to dig and kill them wherever they may be at work. A good method also consists in making up a poisoned mixture consisting of bran or corn meal with water enough to cover it, to which is added a little molasses and some Paris green. A tablespoonful of this mixture should be put out in the garden late in the day, at intervals of about every five feet. The worms work at night and will be killed by eating this poisoned mixture. In the corn field, however, it is doubtful if this method would pay unless the worms were very numerous. It is perhaps better to plant more seed than is necessary, so as to allow for some of the young plants being destroyed. Sod land which is to be planted in corn should be broken up in the fall, as this will expose many of the cutworms upon the surface, where they will be picked up by birds or die from lack of a food plant.

THE LIGYRUS STALK BEETLE.

(*Ligyrus gibbosus* De G.)

The mature form of this insect is a black oval beetle quite similar in appearance to the May beetle, and the Euphoria beetle shown in Fig. 13. The larvæ feed upon the roots of grass and in early spring the beetles are often dug up by persons working in grass land. It is quite common throughout the South, and the larvæ no doubt do much damage to grasses. The beetles damage corn by feeding on the stalk just above ground, in much the same manner as do the larvæ of the corn bill-bugs in bulbous grasses as shown in Fig. 11. When a stalk is attacked it presents a wilted appearance, but after a few days of favorable weather may recover from the effects of the attack; many of the stalks, however, are nearly eaten off and do not recover.

These beetles as a rule do not damage corn, but the following serves as a good illustration of how insects will change their food plant when occasion requires. In June of this year, many reports were received from Adams county of damage being done by these beetles and we were at a loss as to how to account for the injury. Upon investigation, however, we found the following to be the situation: The beetles were doing damage only in a limited locality, and had done the most damage upon a plantation where some 3000 head of cattle were pastured last year. The land was not plowed until spring, and the corn was planted immediately afterwards. These facts explained the whole matter. The beetles were attracted to the pasture last year by the droppings of the cattle, and had deposited their eggs in the grass. The larvæ fed on the roots of the grass last season and changed into mature beetles just before the ground was broken. The corn planted immediately afterwards, was attacked by the beetles, as it was the only vegetation on the land. If the land had not been broken up, the beetles would probably have fed on the grass and deposited their eggs as usual. This beetle in time may so change its habits as to become a corn pest, but at present this is not the case.

Fig. 13. THE EUPHORIA CORN BEETLE. Twice natural size. (Original)

REMEDIES.

There is no remedy for these beetles after the attack has begun, but a good preventive is to plow up sod lands in the fall, thus exposing the larvæ upon the surface where they will be picked up by birds or destroyed by the changing conditions of the weather during the winter.

THE EUPHORIA CORN BEETLE.

(*Euphoria sepulchralis* Fab.)

This insect is a small black beetle, with light yellow spots on the wing cases, which is often found in autumn either at the top of an ear of corn, or on the inner side of the leaves, near their base where they join the stalk. The beetle is shown twice natural size in Fig. 13. It sometimes feeds upon the leaves and stalk, but as a rule eats only the sweetened moisture to be found between the stalk and the

inner base of the leaves. Should they ever be numerous, they can be easily plucked off by hand.

Other Insects Which Injure Corn.

Among the more common corn insects other than those mentioned are the followlng:

Wire Worms (Fig. 14), which are the larvæ of the snapping beetles, do much damage in some of the northern states, but they are comparatively rare in the South and hence do but little damage.

The corn aphis can generally be found in the corn fields, but it rarely occurs in numbers sufficient to cause damage to any extent.

Several species of stalk borers work within the stalk, and where single stalks are noticed which are withered, they should be examined to note the cause. Most of these borers live over winter in the stalk, but if these are gathered in the fall and used as fodder, it will greatly lessen their numbers. With many it is a common practice to leave the stalks in the field until the spring plowing, and this practice gives the borers a good opportunity to increase.

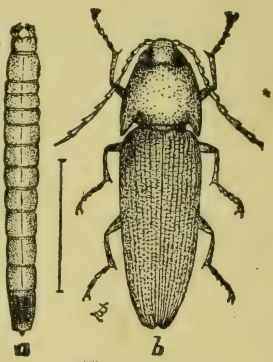

Fig. 14.
A SNAPPING BEETLE. *a*, larva; *b*, beetle. (After Bruner.)

Summary of Remedies.

The reader will perhaps have noticed that under the head of remedies for nearly all the foregoing insects, fall plowing in one way or another has been mentioned. We wish here to call special attention to this point. In this state and throughout many localities of the South, land washes considerably and all possible means should be taken to prevent this by hillside ditches, and the like. With some land it would not be advisable to plow in the fall owing to danger of washing, but in the case of sod land or land which has been allowed to become grown over with grass, it will pay to break up the sod in the fall as it will leave the soil in better condition for working early in the spring. Fully three-fourths of our injurious insects spend a part of their lives upon or within the ground and autumn is the best time for

their destruction. By fall plowing the larvæ and pupæ are exposed upon the surface where they are picked up by the birds, or killed during the winter by sudden changes of the weather. Many larvæ also will die during the winter from lack of food, and insects which pass the winter in the ground as pupæ are killed by the breaking up of the compact earth surrounding them. Recent investigations regarding the food of birds show that these do immense good in destroying larvæ and pupæ during the winter. Sod land contains many insects, and the case of the Ligyrus beetle already mentioned serves as an illustration of the fact that these insects will work upon other plants aside from grass, if the land is not plowed until spring.

When corn is "laid by" too early, the land becomes covered with a thick growth of crab grass and weeds, forming a suitable place for many insects to deposit their eggs. On the Station farm it is our practice to sow cow peas between the rows of corn when the latter is "laid by." This method is practiced principally on account of the effects of the peas as a fertilizer, but at the same time the method has many advantages from an entomological point of view, as the peas attract less insects than would a miscellaneous assortment of weeds and grasses.

Owing to the danger of washing when land is plowed in the fall, a much better farm practice than fall plowing consists in the breaking up of sod and other lands during the summer and planting cow peas, either broadcast or in rows to be cultivated. This method practically accomplishes the same results as fall plowing so far as regards the insects, and considering the great fertilizing value of the peas, the method cannot be too strongly recommended.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 37.

FRUITS AND VEGETABLES ON THE GULF COAST.

Report of the Ocean Springs Branch Station.

F. S. EARLE.

AGRICULTURAL COLLEGE, MISS.

MARCH, 1896.

The bulletins of the Station are sent free of charge to all farmers in Mississippi who apply for them.

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REPORT OF THE OCEAN SPRINGS BRANCH STATION.

INTRODUCTORY.

The Ocean Springs branch of the Mississippi Experiment Station was established in January, 1891, principally for the purpose of ascertaining, as definitely as might be possible, the kinds of fruits which could be grown to the best advantage on the Gulf Coast, what fertilizers are most effective, and what obstacles to his success the horticulturist would probably encounter. While the testing of fruits was made the main feature of the work, considerable attention has also been given to the growing of vegetables and, incidentally, to the cultivation of a few other crops such as are essential parts of an intelligent rotation.

This branch station has now been in operation five years, and while this report is, primarily, of work and observations on the experiment grounds, such facts and experiences as have been gained from the somewhat extensive plantings of fruit trees and market gardens which had been made in the immediate vicinity during the five to ten years immediately preceeding the beginning of our work have been drawn upon freely in this endeavor to place the whole truth before the public.

Many of our results have been surprisingly successful, while others have been very disappointing, and the list of total failures is by no means brief. No attempt is made to give a detailed account of all the various tests and experiments which have been made, but rather to give the combined results secured, and so to present in a compact form something of the horticultural possibilities and limitations of the Gulf Coast region. For more readily understanding the behavior of the various plants which have been tested it is necessary to state something of the peculiar soil and climatic conditions of the region in which the work has been done.

SOIL AND CLIMATE.

The proximity of the Gulf of Mexico has, of course, a marked effect on the climate, giving milder winters and less intensely hot summers than in the interior of the State. the extreme minimum temperature observed for winter being 12 degrees, and the maximum for summer 102 degrees. Killing frosts are liable to occur at any time from the middle of November until the first of April. Cold snaps during the winter, sufficient to kill orange and young fig trees, occasionally occur, though they are usually of short duration, being followed by warm and open weather. The hardier garden vegetables, such as turnips, cabbage, lettuce, radishes, etc., grow well in the open ground all winter without injury from cold in ordinary seasons. It is not necessary to provide glass to cover hotbeds and cold frames for forcing early tomato, cucumber and other plants. There is enough warm and sunny weather to bring such plants forward well by using cloth covers for protection at night, though it is necessary to provide hay or some other extra covering for very cold nights.

The average rainfall is abundant, about 60 inches annually, but in its distribution the year can be divided into four well marked seasons; the fall and spring being dry, while mid-summer and mid-winter are wet. The spring drouth is often so pronounced as to be a serious drawback to the gardener, while the over abundant rains in July frequently injure the ripening grapes, figs and peaches.

The coast soils are mostly poor and sandy, and will not produce crops without a liberal application of fertilizers. They usually contain a fair amount of vegetable matter which give them a good color and a mellow, loamy texture, but they are very deficient in potash and phosphoric acid. The application of both these substances, and especially the latter, is absolutely indispensable for the production of paying crops of any kind. Chemical analyses show these soils to be very deficient in both, but practical experience shows that phosphates are a much more necessary ingredient of a fertilizer than is potash. Fairly good crops can often be grown by the use of acid phosphate alone, but when potash has been used without the phosphate the result has never been satisfactory. Florida "soft phosphates" were used quite extensively in 1895, but apparently produced less effect than an equal value of acid phosphate. For most purposes a complete fertilizer should be

used, but it should always be rich in phosphoric acid. A mixture containing one part of kainit, two of cottonseed meal and three of acid phosphate is recommended for fruits and corn, with a somewhat larger proportion of meal or the addition of stable manure for vegetables.

Most of the coast lands are rather low and flat, so that the subject of adequate drainage for carrying off the heavy summer rainfall is a very important one. The land usually lies in a succession of gentle swales and low ridges so that it is nearly always possible to find an outlet for drains and ditches. It is only the ridge land that is regarded as being fit for cultivation. The swales, often called "savannahs," are kept wet by the seepage from the ridges, and so can be cultivated only after thorough ditching. Back from the coast the land rises gradually and the ridges become higher and better drained. The lands ten to fifteen miles from the gulf are usually much better adapted to farming, and especially to fruit growing, than are those within two or three miles of the coast. The ridge lands were all originally covered by a heavy growth of the long leaf pine, *Pinus palustris*. The savannahs are also often covered by a scattered and more or less stunted growth of pine, but in other cases they are simply open meadows with scarcely any tree growth. Both ridges and savannahs are covered with a carpet of grasses and other herbage, but there is almost no underbrush. Where the drainage water from the savannahs accumulates in sufficient quantity to cut a channel it soon becomes bordered by a tangled growth of broad-leaved evergreen and deciduous trees and shrubs. Such thickets are "bay-heads" or, if of considerable size, "swamps." On nearing tidewater these streams often have more fall and cut channels deep enough to thoroughly drain the adjacent bottom lands, and these drained areas are called "hammocks." They occur not only along the smaller streams, but frequently border the larger bayous and sometimes the shore of the gulf itself. The hammocks, like the swamps, are characterized by the tangled growth of evergreen and deciduous trees and shrubs in striking contrast to the adjoining open and grassy pine lands. The hammock soil has rather more natural fertility than that of the pine lands, and when fresh will produce crops with less fertilizer. It is light and warm, and matures crops earlier than the pine lands, and so is better adapted for vegetable growing, but it occurs only in limited areas.

All the common garden vegetables can be grown during some portion of the year with more or less success, and the family table need never be without fresh vegetables at any season. There are, however, numerous climatic difficulties and fungous enemies to be encountered, to which reference will be made in discussing the different crops.

With fruit the range is more limited. It is too far south for assured success with most northern varieties, and still the winters are too cold for safety with the sub-tropical kinds. There are enough, however, which are thoroughly at home here to give a continuous succession for the greater part of the year, and many more with which sufficient partial success can be expected to justify planting them in a small way for home use. It is interesting to note the behavior of many northern varieties when subjected to such unaccustomed climatic conditions. It would naturally be expected that the mild weather of mid-winter would tempt the northern strangers into unseasonably early growth and bloom, and that failure might result from that cause. The fact is quite the reverse of this. In February the LeConte pear, and the Peen To and Honey peaches are in full bloom, and the sub-tropical orange and fig frequently start into dangerously early growth, but the northern Bartlett pear, and the Alexander and Crawford peaches still stand perfectly dormant, apparently waiting for winter, and thinking the season to be an unusually long and mild fall. When they do finally start it is slowly and with a lack of vigor which tells of their uncongenial surroundings, though later in the season they may partially recover and make a fairly good growth. By the promptness with which growth starts in the spring it is possible to make a close guess as to what varities will be permanently successful.

INSECTS AND DISEASES.

Most of the insects and diseases found further north are common and destructive, the most notable exceptions being the Colorado potato beetle, the codlin moth, and the apple and pear scab, neither of which has been observed here. There are, however, several other plant enemies peculiar to this region which will be considered in detail in connection with the various crops. Cut-worms of various kinds are often exceedingly abundant and destructive. The ten-spotted Diabrotica, besides being a corn-root worm as a

larva, passes the winter in the adult form, and feeds voraciously on many kinds of vegetation and is often so abundant as to be a general nuisance. It is particularly fond of rose petals in early spring, and often injures young cucumber and melon plants. *Heterodera radicicola*, the nematode worm, causing root-knot or root-gall on many kinds of vegetables and fruit trees, is often a serious pest. Very few cultivated plants are known to be invariably exempt from its attacks, and no reliable remedy has been found. Grasses and fibrous rooted plants are usually less affected than are those with more fleshy roots. When ground is known to be infested it is probably best to turn it out or pasture it a few years before using it again for cultivated crops.

With soil and climatic conditions so different from those in other parts of the country, it is not surprising that results should vary widely from those secured elsewhere. As will be seen from the following pages the list of plants which have been tested, in both fruits and vegetables, is quite comprehensive.

FRUITS AND NUTS.

ALMONDS.—Four varieties were planted, but all were complete failures. The trees were repeatedly defoliated by a leaf-spot disease; probably *Cylindrosporium*, and all the varieties tested, including the best California kinds, were equally worthless.

APPLES.—No apple trees were planted on the experiment grounds, but from the growth of those in the surrounding country it is evident that this is too far south for them to be at home. This is indicated by the slow and listless way in which they start in the spring. They grow slowly and without vigor, though they do not seem to be diseased, and some varieties fruit quite freely. A few native seedlings of considerable merit have been observed, and the testing of all varieties of southern origin to determine which are best adapted to the soil and climate is a promising field for further experiment. As stated before, the scab, (*Fusicladium*) so troublesome in the North, has not been observed. The leaf rust (*Rœstelia*) is also absent, but the fruit is considerably damaged by the "bitter" or "summer" rot, (*Glœospsporium*). Our present experience does not warrant the planting of apples for commercial purposes, but for home use they should be more widely planted.

APRICOTS.—Eight varieties have been planted, but with poor results. The ordinary European and Californian varieties have been complete failures. The trees lack vigor, and are short lived. The foliage is diseased, and the flower buds usually blight without opening, or if they do bloom they fail to set fruit. The recently introduced Japanese varieties are much more hardy. The trees seem quite healthy and vigorous, but they bloom so very early that the fruit buds are usually killed by spring frosts; and when they escape that danger the fruit is so much larger and more attractive to the curculio than either peaches or plums at the same season that it is quite uniformly wormy. For these reasons they cannot be recommended for general planting.

BANANAS.—Cultivated for ornament only. Even the most hardy varieties are usually killed to the ground each winter, and so do not fruit, as in this climate the stalks are biennial and do not fruit until the second year.

BLACKBERRIES.—Wild blackberries are abundant and some of them are very good. The Dewberries (*Rubus trivialis*) are usually considered more desirable than the high bush kinds. They ripen in April and bear much more abundantly than do the northern wild species. It would seem that the selection and cultivation of the better kinds among them offers an attractive field for profitable enterprise. The ordinary cultivated varieties of blackberries grow well when planted on soil which has been suitably enriched. A few wild plants producing fruit of a very superior quality have been removed from the woods to the experiment grounds, where they have borne two heavy crops, and have been entirely free from the rust. The red rust (*Cæoma nitens*) is seldom seen among the wild plants, though it develops abundantly on plants brought here from the North.

CHERRIES.—Cultivated cherries are almost unknown in this region, though the wild cherry (*Prunus serotina*) occurs frequently in the dry hammocks. Thirty-four varieties were planted on the experiment grounds in 1893. Some have died, none have borne fruit, and none give much promise of ultimate success. The sweet varieties seem to grow better than the Dukes and Morellos, but none of them can yet be recommended.

CHESTNUTS.—The dwarf chestnut or chinquepin (*Castanea pumila*) is a common shrub in the hammocks, but

neither the common American nor the Spanish promise to be successful. Trees of both species were planted in 1891, but very few are now living. The foliage is unhealthy, and large branches, or sometimes even the whole top of a tree dies suddenly, from no ascertainable cause. The Japanese varieties have not yet been tested.

CURRANTS.—An entire failure.

DEWBERRY.—See blackberry.

GOOSEBERRIES.—Also a failure.

GRAPES.—Grapes are more uniformly successful here than any other of the northern fruits. They grow freely on all kinds of soil; even, strange to say, where too wet for most other fruits. The crop is a sure one, but the yield averages less than in the northern grape regions. Some form of horizontal trellis similar to the "Munson," where the fruit hangs in the shade of the leaves, is greatly to be preferred, as the fruit is much less liable to injury than when exposed to the sun and dew. They are subject to all the more common diseases excepting the black rot (*Physolospora*) which seldom or never occurs. Powdery mildew (*Uncinula*) is troublesome only on the European varieties. Downy mildew (*Plasmopara*) sometimes defoliates Delaware and Triumph late in the season, but has not been observed on other varieties. Anthrancose and root-rot are the two most serious diseases of the vine, while the ripe rot or bitter rot (*Melanconium*) does much the most damage to the fruit. This attacks the berries and the fruit stems just as they are beginning to ripen. The attack on the stems is the more serious as it makes them dry and brittle, causing the berries to drop off, or "shell" badly while on the way to market. It also develops rapidly on the berries during transit, and is doubtless responsible for so many shipments of southern grapes reaching the market in "bad order." Spraying with Bordeaux early in the season does not seem to prevent it. Clusters hanging in the shade are much less likely to be affected than are those exposed to the sun and dew, and it is for this reason that the horizontal trellis is so strongly recommended.

The slug, or saw-fly larva sometimes defoliates the vines early in the season, but it can be controlled readily by the use of Paris green. The leaf folder is a much more serious pest as it comes just when the fruit is ripening, when the use of arsenites is inadvisable. It does little harm to the present crop, but if abundant it greatly weak-

ens the vines for the following year. Hand picking of the infested leaves can be resorted to in the garden, but is hardly practicable for a large vineyard,

A careful selection of varieties is essential, as all are not equally successful. None of the European or *vinifera* type can be recommended. They may grow fairly well for a time, especially if trained against the side of a building, but they are much troubled with mildew and other diseases, and they start into growth in the spring so much earlier than the American varieties that they are often injured by frosts. Of the standard varieties of the *Labrusca* type, Champion, Delaware, Concord, Ives and Niagara can be recommended, while Moore's Early and Worden are sad failures. Among the hybrids, Black Eagle, Lindley and Wilder are quite promising. Herbemont is planted more extensively than any of the *Æstivalis* or of the *riparia* type, though like most of the late varieties it is often severely damaged by the bitter rot. Of course the Scupernongs, or *rotundifolia* type are perfectly at home here. No other fruit, in the North or South, will begin to yield so much fruit with so little labor or expense, and withal such good fruit as do the Scuppernongs. Ripening as they do in August, when other fruits are scarce in the South, they are doubly welcome. The fact that the fruit does not grow in bunches, and that it falls from the stem when ripe, will prevent its being shipped to distant markets, but for near-by markets and for home use it deserves to be even more widely planted than at present. Thomas, a black variety equally hardy and productive, is larger than the ordinary Scuppernong, of different flavor, and is preferred by some. Flowers, another black kind, is poorer than the others in quality, but it is valuable for its lateness, as it will hang on the vines until late in September.

GUAVAS.—Of the different Guavas which have been planted the "Strawberry" or "Cattley" has succeeded fairly well, while all the others have proved too tender. It is killed down by exceptionally cold winters, but as it sprouts readily from the root the loss is only temporary. The fruit is pleasant flavored, and is a desirable addition to the home garden.

FIGS.—Next to the Scuppernong grape, no fruit is more generally cultivated here than the fig. Every old garden has a few fine old trees which never fail to bear heavy annual crops. For several years past the canning factories have bought all the figs they could get, and have

paid good prices for them. This has stimulated considerable planting of fig orchards which has quite uniformly resulted in complete failure. The plantings on the station grounds have been equally unsuccessful. Out of 160 trees representing nearly sixty varieties that have been planted at various times and from different sources, not a single tree is now in a satisfactory condition, and none of them have produced fruit. Many are entirely dead. Those which are still alive throw up feeble shoots each year and are killed to the ground during the following winter. A succession of hard winters and late spring frosts are probably responsible for a considerable part of these failures, as the trunk of a fig tree which is three years old or more becomes more resistant to the cold. Old trees are seldom injured by the hardest freezing of midwinter, and if a frost comes after growth starts in the spring it is the leaves and new shoots only that are injured. Others soon start, and as the fruit forms on the new growth the crop is not much injured, though it may be a little later in ripening. A frost after the leaves start kills a young tree to the ground. It may sprout again from the roots, but its vitality is greatly weakened, and two or three such shocks in successive years usually kills the tree entirely. Most of the older trees stand in dooryards, and dooryard conditions seem particularly favorably for figs. The shelter of buildings and fences gives needed protection from the cold when young, and the roots are not disturbed by the plow. The roots of the fig are very near the surface of the ground, and all cultivators agree that plowing among the trees after the first year is not advisable. Fig roots are often seriously injured by the root-gall nematode, and they are apparently less liable to this attack in the hard dooryard soil than in fields where vegetables have been cultivated. Whatever the cause, the fact remains that the old dooryard trees grow and flourish, while the young orchards, planted within the last six or eight years, have all failed.

The "Celeste" is the only variety in general cultivation. Several other kinds are occasionally seen, but are mostly known under names which are wholly local. It was intended to make the testing of figs a prominent feature of the station work, but the failure to preserve the trees through a succession of hard winters made this impossible.

KAKI.—See Persimmon.

LOQUAT. MEDLAR. JAPAN PLUM.—This interesting evergreen fruit tree is often seen in gardens. The

foliage is attractive, and the flowers which open late in the fall are very fragrant. The fruit ripens in February and March, when its mild subacid flavor is very refreshing and seems appropriate to the season. It is abundant in the New Orleans market, and is occasionally shipped north. The fruit, which is exposed all winter, is sometimes killed, but the tree is sufficiently hardy, and is recommended for all private gardens.

MULBERRIES.—Mulberries grow readily and bear regularly and abundantly, and although the crop is of no commercial value, it is one which is useful at home through a long season. Trees should be planted in the chicken yard and hog pasture, as they will furnish a large amount of food for these animals. In some cases a curious transformation of the fruit into a hard, granular, starchy mass has been observed. Often an entire tree is affected, while in other cases the trouble is confined to single branches. Locally, such trees are said to have "gone to seed," and it is claimed that when a tree is once affected it always continues to bear "seeds." No remedy has been found, and we are entirely unable to account for the trouble, and have never seen it mentioned in print.

NECTARINES.—Seedling nectarines are occasionally seen, but the fruit rots so badly that it is of very little value. Six of the best California varieties were planted on the station grounds, but all were complete failures.

OLIVES.—A few olive trees were planted at Ocean Springs a number of years ago by the late Mr. Maginnis, and they seemed so promising that he afterwards planted an orchard of several acres. This later planting never did well, as the trees grew slowly and unevenly. and finally all were killed by the severe cold of February, 1895.

Mr. Ar. Hopkins, of Biloxi, Miss., who has been engaged in the growing of olives for a number of years, writes us as follows: "The first olives which I planted were fifty trees received from Italy in 1886. These have made a wonderful growth, and have been heavily loaded with fruit, but the fruit has been small. The following year I planted the same number of trees which were received from France, but as they were much older and larger than the Italian, they made a much slower gowth, though they have thrived fairly well, but have not fruited abundantly. The next year I planted 100 trees from California, at the same time that Mr. Maginnis planted his. The growth of these trees has been very vigorous and

bushy, and the fruit very large and fine. I planted my trees between orange trees, and the shade from them, together with the extra care which they received, were doubtless a benefit to the olives. From my experience I am confident that, with intelligent cultivation, the growing of olives can be made a profitable industry along the Gulf Coast. Were it not for a borer which attacks the trunks and larger branches the olive would have no serious enemies here. The severe cold of last spring, which completely destroyed my orange grove, did not affect them in the least, nor has the heat or drouth of our sandy coast lands worked any harm to this hardy tree."

ORANGES.—Oranges have been grown along the coast for many years. Occasional cold winters cut the trees to the ground, but they sprout from the roots and soon make bearing trees again. The winter of 1894–95 was much the most severe on record, and very few trees were left alive. This region is clearly not in the true orange belt, and the growing of them on a commercial scale should not be attempted, though for home use a few trees in sheltered locations will be a good investment. Eleven varieties have been planted on the station grounds, and the Satsuma, if budded low on the *trifoliata* stock, has been sufficiently hardy to escape serious damage. If the earth is mounded about the trunk in the fall, enough bearing wood can always be saved for renewing the top. When a crop is secured the coast orange is of very good quality, sweet seedlings comparing favorably with similar Florida fruit.

PEACHES.—Our experience with peaches on the coast soils has been more uncertain and contradictory than with any other fruit. The trees are usually very short lived, and are subject to many diseases, but occasional trees may be found twenty years old which are still thrifty and able to bear good crops. One large orchard planted near us grew fairly well for four or five years and then suddenly died without having ever produced a crop. In other cases trees have borne abundant crops in two years from planting. Of seventy-eight trees planted on the station grounds in 1891 there are now about a dozen in fairly good condition, another dozen which are quite sickly, and all the others have died.

Success or failure seems to depend largely on the local character of the soil. Only well drained land with a good yellow or red clay subsoil should be selected for planting. On wet land, or on land which has a white sandy subsoil,

failure is certain. The varieties, too, must be selected with great care, and it is only those of the Chinese Cling, of the the Honey, and perhaps of the Spanish types that can be recommended. The native seedlings seem to be of the Spanish type, and some of them are of considerable value. The tree of the Peen To type is sufficiently vigorous, but it blooms in midwinter, and only in exceptional seasons does the fruit escape being killed by frost. The ordinary northern varieties, of the Alexander and Crawford types, on the the contrary, do not bloom until April, long after danger from frost is past, but the trees lack vitality. This is especially true of the flower buds, many of which die without opening, and those which bloom seldom mature fruit.

The peach borer is very abundant and destructive, and the ordinarily recommended remedies seem to be entirely inadequate for its control. The curculio is also very abundant, but perhaps no more so than in many other peach growing sections. In soils infested with the root-gall nematode peaches suffer severely, seeming to be more seriously injured by this worm than any other fruit, except perhaps the fig. Many trees have been observed affected by what some writers have called "crown gall." This is a wart-like growth, sometimes as large as a goose egg, occurring on the larger roots, on the crown, or on the trunk above the ground. Its cause has not been determined. It interferes with the nutrition of the tree, and in extreme cases kills it outright. Trees are often defoliated after midsummer by the leaf rust (*Puccinia pruna-spinosa*) and another fungus, *Cercosporella Persica*, forming a white, mould-like growth on the leaves, often contributes to the same result. *Gummosis*, an obscure disease in which blisters filled with gum form under the bark on the trunk and large branches, is quite common and very destructive. Its cause is not well understood, but it seems to be connected with a general physiological disturbance of the tree.

Notwithstanding this formidable list of diseases and difficulties some fine peaches have been grown on the coast. When first planted the trees grow very rapidly, and they come into bearing very early. They should certainly be planted for family use, and perhaps in a limited way for market, but always with the full understanding that they will probably be short lived, and that sudden failure is liable at any time.

PEARS.—Pears have been tested somewhat largely, forty-two varieties having been planted, including types of

the American, European and Oriental sorts. The northern and European varieties are not well suited to this climate, as they bloom late, and in various ways show that they are out of their latitude. It is still an open question whether any of them will prove permanently successful, and they should be planted only in an experimental way. The Oriental varieties, on the contrary, are perfectly at home. They grow freely and bear abundantly and regularly. So far there has been no trouble from either scab (*Fusicladium*), leaf-blight (*Entomospora*), or the codlin moth. Up to the spring of 1894 the same could have been said of the blight, but in that season the form known as "blossom blight" suddenly appeared in the LeContes in many scattered localities, and badly damaged bearing orchards. It appeared again in 1895, though less virulently, and promises to become a permanent menace to the pear industry. The long blooming period at the South gives this dreaded disease a very serious advantage, as Waite's careful investigations for the U. S. Department of Agriculture have shown us that the germs are carried to the flowers by bees and other insects, where they find in the nectar a culture medium exactly suited to their rapid growth and multiplication. At the North, where all varieties bloom at practically the same time and are out of bloom in a week or ten days, there is not time for such serious damage to be done. On the coast, with a succession of varieties, they will be blooming during nearly or quite two months, and the chances for the spread of the infection are much greater.

Before the advent of the blight the difficulty was not in growing the pears, but in finding a market for them. This difficulty is not likely to increase. The LeConte and Keiffer, while not first-class in quality are, when properly handled, really much better than they have been given credit for, and they are rapidly gaining a recognized place in the markets of the country. The rapid spread of the blight through the whole South has served to discourage planting, and the supply of the fruit is not likely to increase in the near future. Notwithstanding the danger from blight the Oriental pears offer one of the best fields for commercial fruit growing.

PECANS.—There seems to be no drawback to the profitable culture of this fine nut except the rather long time required to bring a grove into bearing. The trees are healthy and long-lived, and produce abundantly when of sufficient age. Some of the finest large "paper-shell" vari-

eties originated in this immediate locality and there is considerable interest in propagating them. Unfortunately these fine varieties do not reproduce themselves from the seed with certainty, and great difficulty has been experienced in getting root grafts to grow. It has recently been found possible to successfully top-work trees, even of considerable size, by summer budding, and we have in this the best and cheapest way for establishing groves of named varieties. The trees can be transplanted when young with no more loss than with other orchard trees. Some growers prefer to plant the nuts where the tree is to grow, claiming that such trees are longer lived and less liable to injury by storms than are transplanted trees. We have no data for determining how much, if any, advantage there may be in that method. Lots of seedlings always vary greatly in size, and by planting in nursery rows and selecting those trees of even grade for the permanent planting, the grove will be more uniform in growth than where nuts are planted. The continued planting of pecans is heartily recommended. The ordinary distance for planting, forty or fifty feet apart each way, is so great that while the trees are young they will interfere but little with the use of the land for other purposes.

PERSIMMONS.—The native persimmon is common, but of no special value except in the hog pasture. The Japanese varieties, of which fourteen have been planted, may become a commercial fruit of considerable importance. The markets have been slow to recognize them, but their fine appearance and their really very good quality is gradually winning for them a place. Many of our trees came into bearing two years after planting, and have been exceedingly productive. An excessive dropping or shedding of the fruit sometimes occurs in midsummer, especially in very wet seasons. As the trees begin to grow early in the spring the crop is sometimes injured by frost. The trees are usually perfectly healthy, but in a few cases an obscure disease somewhat resembling pear blight has been observed. On the question of varieties it is still impossible to speak with much assurance. The varieties which have been planted on the station grounds have acted quite differently in different seasons, but probably Among and Tani-Nashi have given the best general results. On the whole, it is a promising fruit.

PLUMS.—Nearly all of what has been said in regard to peaches will apply equally well to plums. When young

the trees, especially of the Japanese varieties, grow beautifully and seem to promise the most satisfactory results. Occasionally this promise is fulfilled, but in most cases the trees become diseased and die without having borne a profitable crop. Of two trees each of twenty-seven varieties planted on the station grounds in 1891 only seven are now living (February 1896), and not more than six have ever borne a good crop. Marianna trees stand the climate better than any others tested, and a number of fine old specimens have been observed, but for some reason they are not fruitful. They bloom abundantly, the fruit sets and grows to the size of a small cherry, when it almost invariably drops off without any known cause.

POMEGRANATES.—This fruit is common, but is usually grown for ornamant rather than for profit. Like the other subtropicals, it is occasionally injured by a severe winter or a late spring frost, but the tree seems entirely healthy, and the fruit may yet win itself a place in the markets.

QUINCES.—The northern varieties are seldom seen here, and give no promise of usefulness. The Chinese quince grows readily. The fruit is large and coarse, but it has merit for jellies and preserves, and should be included in the plantings for home and local use. Like other Pomaceous fruits it is sometimes injured by pear blight.

RASPBERRIES.—These, especially the red varieties, can be grown with moderate success by heavy mulching and manuring, but plantings are short lived and seldom bear enough to make them profitable.

STRAWBERRIES.—Quite successful and easily grown, but from this soil only the firmest varieties will stand shipment. To be most successful, plants should be set in August or September, though they can be planted at any ttme up to Christmas, and if well manured will make a fair crop in the spring. The fruit often begins to ripen in February, and the plants continue to bear until June. With so long a fruiting season, of course the pick is never so great at any one time as in the North, but the total yield is often quite large. Among the varieties which have given the best results are Alabama, Cloud Seedling and Neuman. Bessie, Big Bob, Michel and Wilson are preferred by some. Crescent and Sharpless grow fairly well, but the fruit is too soft even for home use. Many other popular northern varieties are entire failures.

WALNUTS.—Six varieties of the English walnut were

planted on the station grounds, but they did not thrive and all are now dead. The Japan walnut (*Juglans Sieboldiana*) is more promising, as the trees are still living and have made a fairly good growth, though they do not seem very vigorous, and may fail before reaching maturity.

VEGETABLES.

Nearly all of the common garden vegetables have been grown with greater or less success, and there is no reason why an abundant supply for home use should not be had throughout the entire year, The great distance from the principal market centers, with the consequent high freight charges and long time in transit, together with the large amounts of fertilizer required, are points which should be carefully considered in planting commercially. On the other hand, the cheapness of the lands and the mild climate which enables the truck farmer to grow two, or even three crops from the same land during the year, are compensating advantages which should not be lost to sight. On the whole, however, it must be admitted that the prices obtained during the last few years have not been sufficient to encourage increased plantings.

Among those crops to which we have given greatest attention have been the following:

ASPARAGUS.—This is very seldom seen, though we have secured good cuttings in two years from the seed. The yields secured have been smaller than at the North, but it should be more generally planted,

BEANS.—Nearly all kinds which we have planted have done well. String beans for early shipment are one of the staple market crops, and butter beans are planted largely for the local market, as that is one of the few crops which continues to yield during the late summer. The small or Sewee varieties have been more prolific than the large Limas. We have found the Red Kidney a valuable crop, as it grows easily, requires but little fertilizer, yields well, and the dry beans find a ready local market. Unless planted early the crop will not mature before the summer rains, when it will be hard to cure.

BEETS.—We have been successful with beets only when planting very early, and find that they need very heavy manuring.

CABBAGE.—We have grown heads in the late fall from seed sowed in shaded beds in August. Seed for the

spring crop is sown in November in sheltered beds or canvas covered cold-frames, and the plants are set in the field in January. Late spring cabbage have rarely been successful on account of the worms. We have done well with cauliflowers occasionally, but here they are much more difficult to grow than cabbage.

CARROTS.—Have been grown readily in early spring, but have had very little shipping value.

CORN.—Sweet corn grows well early in the season, and we have made good crops from successive plantings made from February 1 to May 1. Later in the season it has not succeeded so well, being often greatly injured by the boll worm. Singularly enough it is seldom planted, the ordinary field varieties being grown for table use.

COW PEA.—We have found this the most useful legume which we could grow for use in green manuring, and it is also used largely as a garden vegetable as well as for forage. It is one of the most important of southern agricultural plants, and its increased use cannot be too strongly urged.

CRESS.—Watercress has grown very readily, and when once planted in a spring branch or other moist place it has cared for itself without further attention.

CUCUMBER.—This is a standard crop for northern shipments. We have succeeded best by planting seed in dirt bands under canvas-covered cold frames about the middle of February. They have then been ready to go to the field by March 20, which is as early as is safe in ordinary seasons. For a later crop seed may be planted in the open ground from March 10 to 15. It is well to replant the same hills a week later in case the first plantings should be caught by a frost. We find it best to plant not more than two or three feet apart in the rows, so that the vines will cover the ground quickly, though of course the soil must be made very rich for such close planting. The striped beetle, so well known as an enemy of the cucumber, is often abundant, though it usually does but little harm as it does not appear until about the middle of April when the vines should have covered the ground. If very abundant it injures the foliage sufficiently to shorten the yield. A small leaf-hopper sometimes causes a similar injury, and the spotted Diabrotica is often a destructive pest in the seed beds and when the plants first come up in the field. One season a large field was badly damaged by doves. Before they were detected the birds went along the rows

and ate off the seed-leaves just as they came through the ground. Cucumbers are a heavy crop to handle, and when prices are low freight charges consume the profits.

EGG PLANT.—This plant is subject to a blight which causes the entire plant to suddenly wither and die. The blight is probably identical with the tomato blight, which will be discussed later. When free from this disease, the plants are thrifty and prolific.

KOHL-RABI.—Like all vegetables belonging to the cabbage and turnip family, this grows readily during the cooler part of the year. Here it grows as easily as do turnips, and is much more delicate in flavor. It is not as widely grown as it deserves.

LETTUCE.—This crop has grown readily during the fall, winter and spring. When thoroughly enriched, this light sandy soil suits it admirably, and fine heads can be grown in the open air.

MELONS—MUSK.—We have found the requirements for muskmelons and cantaloupes much the same as for cucumbers, and they need the same general treatment. If the crop ripens during rainy weather, which is often the case, it is liable to serious damage from cracking and rot. The melons are often bored into and ruined by the boll worm, and the varieties with a smooth skin are badly injured by sunburn, while the heavily netted varieties escape this injury.

MELONS—WATER.—This soil and climate produce a very fine quality of watermelons and they are quite extensively grown. Unfortunately they are subject to a serious disease known as the "wilt" or "blight." It is usually not observed until the vines have run so as to begin to cover the ground, when suddenly the leaves as a whole, or perhaps at first only those on a single branch, will be seen to wilt and become limp. Vines thus attacked soon die, and whole fields of promising vines are sometimes destroyed by this blight in a very few days. When the disease once appears on a field it is useless to plant it in melons for a number of years, as they will surely die. How long the infection remains in the soil has not been determined. No remedy has been found, and in order to avoid the disease it is necessary to plant on fresh land each year. Even this does not always insure success, as the melons occasionally blight on new land which has never before been in cultivation. In his preliminary report on Southern Tomato Blight,‡ Dr. Halsted suggested that this melon blight might

be the same as the blight affecting tomatoes. Later experiments undertaken at this place† to test the matter did not support this view, and recent investigations by Dr. E. F. Smith of the U. S. Department of Agriculture, show conclusively that there is no connection between the two diseases.

MUSTARD.—Like the other Crucifers, it has grown finely during the cooler months.

OKRA.—A standard crop here, and one of the few which continue in season during August and September. It is usually entirely free from disease, but is occasionally defoliated by a leaf-blight (*Cercospora Hibisci*).

ONIONS.—We have grown good crops in the spring from seed sowed in the fall, and no special diseases have been observed.

PEANUTS.—All varieties have grown very well, but the larger running kinds often fail to fill well and make too many pops. The small, erect-growing Spanish nut does much better, and is a doubly valuable crop, as the tops make an excellent quality of hay, while hogs can be turned into the field to harvest and fatten on the nuts. Like other leguminous plants, this crop acts as a nitrogen gatherer, and so adds to the fertility of the soil where it is grown.

PEPPERS.—All varieties have grown readily and fruited abundantly. Plants are sometimes killed by tomato blight, but seem more resistant than either egg-plants or tomatoes.

POTATOES.—Irish potatoes have usually done well when planted early for a spring crop, and they are quite largely grown in this section for the northern markets. As previously mentioned, the Colorado potato beetle is unknown here, and the crop is not troubled by other insects. No trouble from scab need be anticipated when clean seed is used. The Macrosporium disease occurs, but is seldom troublesome, while the dreaded northern potato blight, *Phytophthera infestans*, is wholly unknown. We have, however, a southern potato blight which is often very destructive. This is a bacterial disease very similar to, if not identical with the tomato blight. It manifests itself first by the sudden wilting and dying of the tops. This usually occurs after the new potatoes are somewhat forward, and sometimes after they are nearly full grown. If dug at once

‡Bulletin No. 19, Mississippi Station.
†Sixth Annual Report, Mississippi Station.

these may be sound and fit for use, but the disease soon extends down the dying stem and causes them to decay. If the potatoes from a diseased hill are cut open a brown line can often be traced under the skin, showing that the disease has reached them, though they may appear perfectly sound externally. Such potatoes, when mixed with others in the barrel, will rot while on the way to market, and so form centers of infection which may destroy the value of the whole shipment, and it is proba le that the presence of this disease explains the poor keeping qualities of many shipments. No remedy for the disease is known, and the only preventive is planting on uninfected land. It is another cause which enforces crop rotation. Seed from the spring crop is often saved and planted in August, for a fall crop. For this fall crop it is necessary to sprout the potatoes before planting, and to plant whole potatoes. The potatoes from this second crop have been quite free from disease, and have kept well through the winter.

PUMPKINS.—These have not succeeded as well as in the North.

RADISHES.—These have been grown in the open ground without trouble from September to May.

RAPE.—Our experience with this plant has been disappointing. The related Crucifers all grow so readily that it was planted with great confidence, but has never been successful.

RHUBARB.—A complete failure. Several plantings have been made, but the plants have never survived the first summer.

RUTABAGAS.—These have been very successful. As they can be planted from August to January they are valuable for winter forage.

SPINACH.—Hard to get a stand, and seldom fully successful.

SQUASH.—Summer squashes have been grown quite successfully. When started in dirt bands, under canvas as described for cucumbers, they grow readily, and are one of the valuable crops for northern shipment.

TOMATOES.—Tomatoes have received more attention than has any other vegetable. A very fine early crop can sometimes be grown and when successful is very profitable. There are, however, three quite serious enemies to the crop. The boll-worm is everywhere recognized as a tomato pest, and here it causes very serious losses in some seasons. Black rot, or "blossom-end rot," is a widely known disease

that also gives great trouble. The southern tomato blight is, however, more to be dreaded than either of the others, as it kills the plants very quickly just before the fruit begins to ripen, and when the soil is once infected it becomes impossible to grow tomatoes on it the following season. How long the infection may live in the soil has not yet been determined.

This disease was first observed at Crystal Springs in Copiah county eight or nine years ago. Its ravages there and at other points where it had been observed in the state were so severe that in 1891 the Station commissioned Dr. B. D. Halsted, of the New Jersey Station, to visit the infested localities and make a special study of the disease. His report forms Bulletin No. 19, of this Station. He determined the bacterial nature of the disease, and first suggested its probable identity with the similar disease of egg plants and potatoes. Field experiments suggested by Dr. Halsted for the prevention of the disease were carried on by the writer during four years at this branch station, and the results obtained up to that time were published in the Sixth Annual Report of the Station, in 1893. While the experiments seem to indicate some benefit from the use of lime, kainit, and Bordeaux mixture, they cannot be considered as conclusive, and the only safe preventive lies in a careful crop rotation. The disease had not been reported outside of Mississippi until the summer of 1895, when Dr. Erwin F. Smith of the U. S. Department of Agriculture found it near Charleston, S. C. Failure of the tomato crop in the neighborhood of Mobile, Ala., is undoubtedly due to this disease, and it will probably be found in many other localities. The tomato blight found in Florida by Prof. Rolfs of the Florida Station is an entirely distinct disease, which is not bacterial in its origin.

TURNIPS.—This crop has been planted during each month from August to March, and with good returns. With heavy manuring both turnips and rutabagas give large yields, and they can be grown profitably for stock feed since they occupy the ground only during the winter.

YAMS.—Sweet potatoes or yams are, perhaps, the most important vegetable crop for the Coast country. They are propagated in various ways. Sometimes the potatoes are cut and the pieces planted in hills as are Irish potatoes, and when planted in that manner the pieces are called "mother potatoes." It is more common to bed the potatoes and then draw the sprouts for planting. In either

case only enough to produce a supply of vines are planted in the spring, and these vines are cut and planted for the main crop during the rains of midsummer. Vine cuttings planted as late as August 10 have sometimes made a fair yield, but it is better to plant from the middle of June to the middle of July. A large number of varieties are grown here, but nearly all are known under local names, almost every grower having his special favorite. The varieties most esteemed belong mostly to the cut-leafed or yam type, though recently the "Dooley," a variety resembling the pumpkin yam, but having entire leaves, has become quite popular. Sweet potatoes require but little fertilizer, but they have succeeded best on rather new land. It is the most profitable crop to plant on raw and freshly broken sod

EXPERIMENTS IN BULB GROWING.

Nurserymen and florists import annually large quantities of Dutch and other foreign flower bulbs. The possibility of supplying this demand with southern grown bulbs has recently attracted some attention, the North Carolina Station in particular having done considerable work in this line which has been quite successful. In order to test the possibilities of the Gulf Coast for this purpose, in 1892 Henry A. Dreer, of Philadelphia, kindly sent us several thousand bulbs, including many varieties of hyacinths, narcissus, tulips, callas, etc. The cultivation of these bulbs has been carried on quite extensively during the last three years, and the results seem to be quite conclusive. All varieties of narcissus amaryllis, crinum and gladiolus can be grown easily and successfully, while tulips, hyacinths and callas will be disappointing.

FORAGE PLANTS.

Numerous tests of forage plants have been made here to determine the values of the different species for the Gulf Coast. Among the true grasses which have been tested here have been Timothy, Kentucky blue grass, orchard grass, Italian ryegrass, tall meadow oat grass, redtop, rescue grass, and Texas blue grass. All except the last three were complete failures. Redtop alone among the common northern grasses stands the long summer well,

and makes a green sod through the winter. It will probably prove a valuable grass for winter pasture, but does not grow tall enough to have much value for hay. Occasional plants of rescue grass make a good winter growth, but we have never been able to secure a full and even stand over large areas. Texas blue grass succeeds fairly well if the soil is rich, but otherwise it is disappointing. It does not come well from the seed, and propagation from the roots is tedious work. It is doubtful if any of these grasses are equal to the native "carpet grass" (*Paspalum platycaule*) as a winter pasture, and they certainly do not compare with it for summer grazing. It is hard to overestimate the value of the carpet grass for these light sandy lands. It seldom grows tall enough for hay, but no other grass, except Bermuda, makes so dense a sod on these lands, or bears tramping and grazing so well. Unlike Bermuda, it is green all winter. It is very nutritious, all kinds of stock are fond of it, and it is an ideal pasture grass. It "comes in" spontaneously wherever the land is heavily and continuously pastured.

Watergrass (*Paspalum dilatatum*) is another very valuable native which is also green through the whole year. It grows more in bunches, and does not make as dense a sod as the carpet grass, but on moist, rich land it grows tall enough to make a heavy crop of hay. Unfortunately it does not seed well, and so multiplies slowly. Bermuda of course grows well and makes the best of pasturage through the summer, and on rich land it makes a good yield of very fine hay. Its two objections are, that it dies nearly to the ground in winter, and that it is hard to eradicate when once established. Crabgrass (*Panicum sanguinale*) and bullgrass (*Paspalum purpurascens*) are two valuable native grasses which should not be overlooked. They are both annuals which appear spontaneously in the fields after ordinary crops are laid by and, with the Mexican clover (*Richardsonia scabra*), they furnish the bulk of the hay made on the coast. They all make very good feed, though the crabgrass is most salable on account of its lighter color.

Among the legumes, cow peas, Spanish peanuts, and beggar-weed (*Desmodium molle*) can be strongly recommended. The latter is seldom seen, but it grows very easily, and yields a much greater weight of forage than either of the others. It should be planted more widely. Lespedeza succeeds fairly well, though seldom large enough to cut for hay. It has made its appearance here within a very few

years, but is spreading rapidly, and has gained a good hold in many places.

Many other common leguminous forage plants have been planted repeatedly, but none of them can be recommended. Those which have been tested include red and white clovers, crimson clover, burr clover, spring vetch (*Vicia sativa*), hairy vetch (*Vicia villosa*), alfalfa, soja beans, seradilla, and others.

CONCLUSIONS.

While every one should be encouraged to grow an abundant supply of fruits and vegetables for home use, and as a side crop for the local markets, it seems unwise to advise the general farmer to engage hastily in the trucking business as his sole means of support. The liability to loss from the uncertain climate and from the various plant diseases mentioned on previous pages is so great, the fluctuations of the markets are so wide, and the high freights and heavy fertilizer bills are so certain that the growing of hogs, sheep or cattle offers a more safe and sure return for labor. Some few special crops for northern shipment may well form a part of an intelligent rotation, but in the long run the farmer who makes his fertilizers at home, and improves his lands by keeping any well bred and well cared for line of live stock, will come out ahead of the one who grows only sale crops, the profits of which must go largely to the railroads and fertilizer factories.

We are fully aware that this Report is not such as will stimulate the immediate planting of large orchards or extensive market gardens, but we are sure that the work upon which it is based has been carefully and thoroughly done, and that the facts and conditions mentioned are those which will probably confront every fruit and vegetable grower in that region. The Station was established for the purpose of ascertaining facts, and we have given the facts as we have found them.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 38.

MISSISSIPPI FUNGI.

(Continuation of Bulletin No. 34.)

S. M. TRACY AND F. S. EARLE.

AGRICULTURAL COLLEGE, MISS.

MAY, 1896.

The bulletins of the Station are sent free of charge to all farmers in Mississippi who apply for them.

ADDITIONAL LIST

—OF—

MISSISSIPPI FUNGI.

Bulletin No. 34 of this Station, published in May, 1895, contained a list of the fungi which had been found by the writers in this state up to that time. Since then a considerable number of species have been identified, and as Mr. Earle has recently become connected with the experiment station of another state, so that the immediate continuation of the work has been interrupted, it seems best to publish the following additions to the list at the present time. Descriptions of such new species as have been published by the authors since Bulletin 34 was issued are included here, and the accompanying list gives new hosts and localities for previously mentioned species,* and 85 species not named in the former list, of which 21 are new. These additions make the total observed genera and species as follows:

Family.	Genera.	Species.
Thelephoreæ	1	2
Uredineæ	16	106
Ustilagineæ	6	23
Peronosporeæ	4	13
Chytridiaceæ	1	3
Erysipheæ	6	21
Perisporieæ	10	28
Sphaeriaceæ	17	30
Hypocreaceæ	3	3
Dothidiaceæ	4	7
Hysteriaceæ	8	17
Discomycetes	10	14
Fungi Imperfecti	47	171
Total	133	430

*These are marked with an asterisk to distinguish them from the species here recorded for the first time.

As in the previous list, no attempt has been made to enumerate the fleshy fungi, and a glance at the above table will show that many other important groups have received but scant attention. Our interest and work have centered in the parasitic forms and, through want of time, the saprophytes have been, for the most part, neglected. As before, we have followed Saccardo in the nomenclature of the fungi, and for the host plants we have used the names given in Chapman's Flora. All of the fungi named in the list are now in the herbaria of the authors.

EXOBASIDIUM Wor.

E. Symploci E. & E.

On Symplocos tinctoria, Columbus.

E. discoideum Ell.

On Azalea viscosa. Ocean Springs.

UROMYCES Lk.

***U. appendiculatus** (Pers.) Lk.

On Phaseolus pauciflorus, Ocean Springs; and P. helvolus, Holly Springs.

***U. Hyperici** (Schw.) Curt.

On Hypericum mutilum, New Albany and Tupelo.

U. Scirpi Burr.

On Rynchospora sp., Ocean Springs.

***U. Spermacoces** (Schw) Thum.

On Diodia teres. Quite common.

***U. Trifolii** (Hedw.) Lev.

On Trifolium pratense, Holly Springs.

PUCCINIA Pers,

***P. angustata** Pk.

On Cyperus strigosus, Westside.

***P. Menthæ** Pers.

On Salvia azurea, Ocean Springs.

***P. Polygoni** Pers.

On Polygonum Pennsylvanicum, Tupelo.

***P. Sorghi** Schw.

On Zea Mays, Tupelo.

P. virgata E. & E.

On Panicum virgatum, Ocean Springs.

GYMNOSPORANGIUM Hedw.

*G. **globosum** Farl.

On Juniperus Virginiana, Ocean Springs.

AECIDIUM Pers.

*Æ. **Pentastemonis** Schw.

On Pentstemon pubescens, Columbus.

PERIDERMIUM Lev.

P. **cerebrum** Pk.

On Pinus tæda, Columbus.

*P. **orientale** Cke.

On Pinus australis, Ocean Springs.

USTILAGO Pers.

U. caricis Pers.

On Carex folliculata, Biloxi. Rynchospora glomerata, Ocean Springs.

U. Hordei (Pers.) K. & S.

On Hordeum vulgare, Starkville.

*U. **Rabenhorstiana** Kuhn.

On Panicum sanguinale, Tupelo.

U. **Sporoboli** T. & E.

On Sporobolus junceus, Columbus. Described in Bull. Torr. Club, Vol. 23, No. 5, as follows:

"Infesting the ovaries, forming a hard greenish compact mass 2-3 mm. in diameter; spores dark fuscous, oval or subglobose; epispore thickly covered with broadly conical tuberculations, 12 to 12 by 15μ."

Usually but few infested ovaries occur on a plant, and the panicle retains its normal form.

*U. **Uniolæ** E. & E.

On Uniola gracilis, Starkville. Found in one small locality only.

TILLETIA Tul.

T. corona Scrib.

The following note by the writers of this bulletin was published in the Bull. Torr. Club, Vol. 23, No. 5:

"This striking smut was first observed by Scribner on *Homalocenchrus oryzoides* and *H. Virginicus* near Washington, D. C., in 1886, and specimens collected by him were distributed by Ellis under the above name in N. A. F., as No. 1896. It has since been collected by Waite in Illinois and Missouri on *Homalocenchrus*, on *Panicum Virgatum* in Illinois, and by the writers in Mississippi on *Homalocenchrus lenticularis* and *H. Virginicus* at Columbus, on *H. lenticularis* at Bairds, and on *Panicum sanguinale* at Starkville. Specimens on *Panicum virgatum* in the Herbarium of the Division of Vegetable Pathology at Washington bear the unpublished herbarium name *T. pulcherrima* Ell. and Gal., but they seem identical with the forms on the other hosts. As no description of this species has been published, we make the following drawn from an examination of all the above montioned material.

Tilletia corona Scrib.

Infesting the ovaries, transforming them into black, curved, horn-shaped masses, sometimes 1 cm. in length, the outer covering firm in texture, showing traces of the cellular structure of the ovary; spores large, spherical, 22-26 μ, dark, fuscous and densely opake when mature, but covered with a hyaline envelope 2 μ or more in thickness, the surface of the dark central mass covered by minute but deep alveolations, this structure being obscured by the opacity of the mature spore, when the thin alveolar walls can be seen only at the periphery, where they appear like numerous spinous projections reaching almost through the hyaline envelope. The remains of the fruiting hypha often persist on the younger spores as a false pedicel.

On various grasses, Mississippi, Illinois, Missouri and Washington, D. C.

Several other species of *Tilletia* have similar large spores with a hyaline outer covering, but in the others the spores are less dark and opake, and the alveolar reticulations are much larger and more easily recognized. These species form a natural group quite distinct from the other *Tilletias*, and might well be considered as constituting a distinct genus."

UNCINULA Lev.

*U. **macrospora** Pk.

On Ulmus alata, Grenada and Water Valley.

MICROSPHAERA Lev.

*__M. Alni__ (DC.) Wint.
On Juglans nigra, Aberdeen.

*__M. Quercina Burr.__
On Quercus tinctoria, Holly Springs.

ERYSIPHE Hedw.

*__E. Cichoracearum__ DC.
On Ambrosia artemisiæfolia, Tupelo; Verbena Urticæfolia, New Albany.

APIOSPORIUM Kunze.

__A. Montagnei__ Sacc.
On Arundinaria tecta, Starkville.

ASTERINA Lev.

__A comata__ B. & R.
On Magnolia grandiflora, Ocean Springs.

__*A granulosa__ (Ve).
On Magnolia grandiflora, Ocean Springs. There seems little doubt that this belongs with the specimens on *Magnolia glauca*, determined as above by Winter (see Bull. 34, p. 98) though the spores are not quite as large and are more nearly spherical than in that form.

__A. inquinans__ E. & E.
On Sabal Adansonii, Biloxi.

*__A. pelliculosa__ Berk.
On Ilex opaca, Columbus.

DIMEROSPORIUM Fckl.

__D. Ellisii__ Sacc.
On Gaylussacia dumosa, var. hirtella, Ocean Springs.

__D. Langloisii__ E. & M.
On Dianthera humilis, Bairds.

*__D. pulchrum__ Sacc.
On Cornus sericea, Starkville.

PARODIELLA Speg.

*P. __perisporioides__ (B. & C.) Speg.
On several species of Desmodium, Westside.

MELIOLA Fr.

***M. amphitrica** Fr.

On Magnolia grandiflora, Ocean Springs.

M. Martiniana Gail.

On Persea palustris, Ocean Springs. This was incorrectly referred to *M. amphitricha* Fr. in Bulletin 34.

M. tenuis B. & C.

On Arundinaria tecta, Ocean Springs. This was distributed under the above name, but without description, as 331 of Ravenel's Fungi Amer. Exsic. Incorrect descriptions have been published by Saccardo, Syll. Fung. 9: 428, 1891, and by Gaillard, Le Genre Meliola: 117, 1892. The following description by one of the present writers (Earle) was published in Bot. Gazette, 21: 225, (April, 1896). It was drawn in part from the Mississippi specimens, and was accompanied by a note giving a complete bibliography of the species: "Meliola tenuis B. & C. nov. desc. Amphigenous, covering small (2-3 mm.), black, orbicular or at length confluent areas; conidia-bearing mycelium light fuliginous, somewhat flexuous, branched, frequently septate, not constricted at the septa, 6-7μ thick; conidia not observed; perithecia-bearing mycelium abundant, dark fuscous, irregularly flexuous and nodular, frequently septate, 8-9μ thick; capitate hyphopodia abundant, alternate, about 20-25μ long; basal cell short-cylindrical, about 8x8μ; apical cell broader, usually irregularly but distinctly three or four lobed, 12-15x12-20μ. setae abundant, rigid, dark and opaque, 200-400x10μ, acute, the tip often bifid, trifid, or occasionally 4-parted for a distance of 10-20μ; asci ovate, thin-walled, often evanescent, 2-4-spored, 50-70x35-40μ; sporidia dark fuscous, 4-septate, constricted at the septa, ends obtusely rounded, 50-60μ long, somewhat flattened, seemingly elliptical, 18-20μ wide in front view, but cylindrical and 12-15μ wide in side view."

DIATRYPE Fr.

D. Azaderachte Cke.

On Melia Azaderach, Starkville.

D. Callicarpæ B. & R.

On Callicarpa America, Starkville.

D. consobrina Mont.

On Arundinaria tecta, Westside.

PHYSALOSPORA Niessl.

P. disrupta (B. & C.) Sacc.

On Smilax rotundifolia, Starkville.

SPHAERELLA Ces. & DeN.

S. annulata Cke.

On Magnolia glauca, Ocean Springs.

S. glauca Cke.

On Magnolia glauca, Ocean Springs. This is determinod as above with some doubt, as Cooke says "sporidia short-lanceolate, 12-14 by 4μ," while in our specimens they are nearly cylindical. and measure 20-24 by 4μ.

S. Ilicis Ell.

On Ilex glabra, Biloxi.

S. Sarraceniæ (Schw.) Sacc.

On Sarracenia flava, Ocean Springs.

DIDYMELLA Sacc.

D. culmigena Sacc.

On Muhlenbergia Mexicana, Starkville.

GNOMONIA Ces. & DeN.

G. Myricæ C. & E.

On Myrica cerifera, var., media, Ocean Springs.

MASSARIA DeN.

M. olivacea Cke.

On Morus rubra, Starkville.

CARYOSPORA DeN.

C. putaminum (Schw.) DeN.

On old peach pits and hickory nuts, Starkville. We do not find this fungus recorded as occurring on hickory, but our specimens agree fully with the description given by Saccardo, and with specimens from Ellis. Peck (44 Rep. p. 29) describes C. minor on hickory nuts, but in his species the spores are 1-septate, while in ours they are distinctly 5-septate.

ZIGNOELLA Sacc.

Z. Magnoliæ T. & E.

On Acer rubrum, Ocean Springs. Described in Bull. Torr. Club, Vol. 23, No. 5, as follows:

"On whitened areas, thickly scattered and sometimes confluent, hemispheric, base slightly sunk in the matrix, rounded above, not papillate, finally opening by a large round ostiolum, black, carbonaceous, surface roughened, about ½ mm. in diameter; asci narrowly elliptical, long-stipitate, 130-150 by 13-15μ; paraphyses filiform, abundant, exceeding the asci; sporidia hyaline, elliptical, ends rounded, 4-guttate, finally 3-septate, not constricted, 22-24 by 5-6μ."

WINTERIA Rehm.

W. lobata T. & E.

On Ilex coriacea, Ocean Springs. Described in Bull. Torr. Club, Vol. 23, No. 5, as follows:

"Hypophyllous, superficial; perithecia scattered, turbinate, collapsing to patellate, and becoming variously ridged and lobed on the thick margins, thin, fragile, not distinctly cellular, black externally and greenish blue within, 300-400μ; asci numerous, thin-walled, ovate, short-pedicellate, about 35 by 15μ, involved in the thread-like gelatinous greenish paraphyses; sporidia hyaline, narrowly elliptical, acute, faintly 3-septate."

On living leaves of *Ilex coriacea*, Ocean Springs, Miss., February 16, 1894, and August 20, 1895.

The February specimens seem slightly immature, so that the characters of the sporidia are made out with difficulty, and the August specimens to be entirely sterile. The same fungus has been detected with specimens of *Asterina peliculosa* on the same host collected in Florida by Th. Holm, and in Georgia by M. B. Waite.

PLEOSPORA Rab.

P. diaportheoides E. & E.

On Daucus pusillus, Tupelo.

OPHIOBOLUS Riess.

O. anguillides (Cke.) Sacc.

On Ambrosia artemisiæfolia, Starkville.

O. fulgidus (C. & P.) Sacc.

On Ambrosia artemisiæfolia, Starkville.

GLONIUM Muhl.

G. macrosporium T. & E.

On dead twigs of Persea palustris, Ocean Springs.

Also found at Auburn, Ala., on various dead twigs. Descriced in Bull. Torr. Club, Vol. 23, No. 5, as follows:

"Perithecia scattered, black, carbonaceous, broadly oval, obtuse, indistinctly longitudinally striate, lips closely connivent, about 1 mm. long; asci cylindrical, thin-walled, 8-spored, paraphysate, about 200 by 35-40μ; sporidia very long, cylindrical, slightly curved, obtuse, unequally uniseptate, somewhat constricted, hyaline or at length slightly tinted, 60-70 by 12-15μ."

The spores are twice as large as in any described species of *Glonium*. It approaches *Tryblidium* in its occasionally tinted spores, and there is one species, *T. turgidium* P. & H. with spores even slightly larger than these.

TRYBLIDIUM Duf.

T. hysterinum Duf.*

On dead limbs, Ocean Springs.

LEMBOSIA Lev.

The region of broad-leaved evergreens along the Gulf coast is wonderfully prolific in forms of *Lembosia*, of which four new species were described in Bulletin No. 34, and in the present list we are able to add five others. When it is remembered that Saccardo gives only four for the United States, and a total of only twenty-six for the entire genus, the discovery of nine additional specis within a radius of five miles is somewhat remarkable. The following notes and descriptions were prepared by the writers and first published in the Bull. Torr. Club, Vol. 33, No. 5:

Lembosia Oleæ n. sp. Hypophyllous, spots none; perithecia scattered, large, flexuous and often branched or compound, about 400 by 80-100μ; subiculum abundant, of long, slender, fuscous, branching, matted threads, 100 or more by 2-2.5μ; sporidia unequally uniseptate, the shorter cell narrower, hyaline (but evidently immature), 12-15 by 4μ.

On leaves of Olea Americana, Ocean Springs, Miss., February 4, 1894, and September 19, 1895.

Lembosza Andromedæ n. sp. Hypophyllous, without definite spots; perithecia scattered or gregarious, linear and occasionally flexed, seldom branched, 250-400 by 50-90μ; subiculum copious, of loosely interwoven and anastomosing threads. 25-40 by 2-3μ; spores unequally uniseptate, oval or biconic, hyaline (perhaps immature), 8-9 by 2.5-3μ.

*Reported in Bulletin 34 as Tryblidiella rufula. See note under that species.

On leaves and stems of *Andromeda nitida*, Ocean Springs, Miss., May 26, 1895.

This resembles *L. Oleae* in its hypophyllous growth, lack of spots or evident mycelium, and in its elongated stipitate asci, but it averages smaller and narrower, and has a less abundant and very different appearing subiculum. The two species seem to form a natural section or subgenus quite different from the other species, which are epiphyllous or more on less distinct spots, and with broadly oval or orbicular asci.

Lembosia Cliftoniae n. sp.

Epiphyllous, on small irregularly rounded whitened areas 1-2 mm. in diameter; perithecia small, oval or linear-oval, usually straight and simple, rather thick and dense, 100-150 by 40-70μ; subiculum very scanty or almost wanting, of few dark colored nodular flexuous threads, 15-25 by 2-3μ; asci obovate, 20-25 by 10-15μ; sporidia oval or biconic, about equally uniseptate, light fuliginous, 9-11 by 4-5μ.

On living leaves of *Cliftonia ligustrina*, Ocean Springs, Miss., September 14, 1895.

Lembosia Ilicis n. sp.

Epiphyllous, on ash-colored spots 3-5 mm. in diameter; perithecia usually linear and simple, rarely branched, 200-300 by 70-80μ; subiculum of numerous slender fuscous threads, 15-20 by 2-3μ; asci oval or oblong, not sipitate, 20-25 by 10-12μ; sporidia elliptical, about equally uniseptate, slightly constricted, becoming olivaceous, 8-10 by 2.5-3μ.

On living leaves of *Ilex glabra*, Ocean Springs, Miss., August 25, 1895.

The microscopic characters are much as in *L. angustiformis* T. & E. on *Ilex coriacea*, but the sporidia are even smaller and more delicate, the stellate blisters so characteristic of *L. angustiformis* are wholly wanting, and the gross appearance on the leaf is quite different.

Lembosia rugispora n. sp.

Epiphyllous, on irregularly rounded, dark brown spots covered with a radiating mycelium; spots 1-3 mm. in diameter; perithecia often stellately compound, or variously branched, about 400 by 100μ when simple; subiculum rather scanty, of two kinds of threads, one pale, multiseptate, about 3-3.5μ thick, the other darker, mostly continuous,

frequently anastomosing, 2.75-3μ, the darker threads bear occasionally erect sessile 4-8-septate dark fuscous clavate conidia, 30-45 by 7-8μ; they also bear occasional sessile orbicular one-celled dark opake bodies (hyphopodia?) 5-6μ in diameter; asci oval, 25-35 by 20-25μ, sporidia large, oval, about equally uniseptate, at length dark fuscous, 15-20 by 8-10μ. When fully matured and freed from the ascus the surface of the sporidia is seen to be prominently roughened by small wart-like projections.

On living leaves of *Persea palustris*, Ocean Springs, Miss., May 26, 1895."

TRYBLIDIELLA Sacc.

T. rufula (Spreng.) Sacc.

On Rhus toxicodendron, Starkville. This name was given in Bulletin No. 34, p. 105, from specimens collected at Ocean Springs and determined as *Tryblidium rufulum* (Spreng.) by Ellis. In Jour. Mycol., V. p. 30, Ellis refers to that specimen and calls it "var. *simplex*" as the sporidia are 1-septate. In Pyrenomycetes of North America, p. 689, he refers this same specimen to *Tryblidium hysterinum* Duf., so the former publication of this species from Ocean Springs was incorrect. We now find it, as above, and also insert *Triblidium hysterinum* Duf. as Ellis' final determination of the Ocean Springs specimen.

GLONOPSIS DeN.

G. lineolata (Cke.) Sacc.

On Sabal serrulata, Ocean Springs.

HYPODERMA DC.

H. Illicinum DeN.

On Quercus sp., New Albany and Starkville.

H. nitidum DeN.

On Solidago. Dead stems, Ocean Springs.

LOPHODERMIUM Chev.

L. Cyrillicolum T. & E.

On Cyrilla racemiflora, Ocean Springs. Described in Bul. Torr. Club, Vol. 23, No. 5, as follows:

"Amphigenous, on irregular brown sub-arid red-bordered spots; perithecia innate, depressed and finally collapsing, broadly oval, lips connivent, 1-1.5 mm; asci cylin-

dric-clavate, about 65-75 by 10μ; paraphyses very numerous, thread-like, exceeding the asci, tips not recurved; sporidia filiform, nearly equalling the ascus, straight and parallel with it."

SCLERODERRIS Fr.

S. concinna (B. & C.) Sacc.

On Persea palustris, Ocean Springs.

STICTIS Pers.

S. Arundinacea Pers.

On Andropogon Virginicus, Starkville.

LECANIDION Rab.

L. atratum (Hedw.) Rab.

On dead corn stalks, Starkville.

PHYLLOSTICTA Pers.

P. Batatæ (Thm.) Cke.

On Ipomœa batatas, Biloxi.

P. Quercus-Ilicis Sacc.

On Quercus virens, Ocean Springs.

SPHAEROPSIS Lev.

S. pericarpi Pk.

On hickory nut hulls, Starkville.

S. punctatum C. & E.

On Lonicera Halliana, Starkville.

SEPTORIA Fr.

S. Mimuli Wint.

On Mimulus alatus, Starkville.

S. Œnotheræ Mart.

On Œnothera sinuata, Starkville.

S. Salicinum Pk.

On Salix nigra, New Albany.

S. Symploci E. & M.

On Symplocos tinctoria, Ocean Springs.

LEPTOTHYRIUM Kunze & Schw.

***L. dryinum** Sacc.

On Quercus obtusiloba, Ocean Springs.

MELASMIA Lev.

*__M. hypophylla__ (B. & R.) Sacc.

On Gleditschia triacanthos, New Albany.

AMEROSPORIUM Speg.

*__A. œconomicum__ E. & T.

On Cow pea, Biloxi and Ocean Springs.

CYLINDROSPORIUM Ung.

*__C. Ulmicolum__ E. & E.

On Ulmus Americana, Aberdeen.

PESTALOZZIA DeN.

*__P. funerea__ Desm.

On Platanus occidentalis, Grenada and New Albany; Vitis, Starkville.

__P. gibbosa__ Hark.

On Vaccinium stramineum, Ocean Springs.

__P. uniseta__ T. & E.

On cultivated grapes, Starkville. Described in Bull. Torr. Club, Vol. 23, No. 5, as follows:

"Acervuli scattered, erumpent, oval or elliptical, opening by an irregular elongated fissure, 50-100 by 100-200μ; conidia elliptical, often somewhat curved, 5-septate, the four medial cells dark fuscous, terminal cells hyaline, 25-30 by 7-8μ; arista single, hyaline, 8-10μ long, abruptly bent at a sharp angle with the spore; stipe very short, bent to the same side as the arista."

SEPTOGLOEUM Sacc.

*__S. profusum__ (E. & E.) Sacc. (Glœosporium profusum E. & E.)

On Ulmus Americana, New Albany. (A. B. Seymour.) Thls was first published as occurring on Corylus Americana, and is given so in Bulletin 34, but a reexamination of the type specimens shows them to be on Ulmus, and it is probable that the species does not occur on Corylus.

RAMULARIA Ung.

__R. areola__ Atks.

On cotton, Starkville.

CONIOSPORIUM Lk.

***C. Arundinellae** E. & T.

On Arundinuria tecta, Bairds.

SCOLECOTRICHUM Kunze.

S. Euphorbieæ T. & E.

On Euphorbia Preslii, Starkville. Also found at Auburn, Ala. (Duggar.) Described in Bull. Torr. Club. Vol. 23. No. 5, as follows:

Hypophyllous, forming prominent olivaceous tufts: spots none; hyphae very numerous, in large tangled clusters, long and flexuous, olivaceous, occasionally septate, marked for more than half their length by scars left by the pleurogenous conidia, 225-275 by 4-5μ; conidia oval or obovate, with a distinct scar at the base, hyaline, minutely granular, continuous or at length faintly uniseptate, not constricted, 20-25 by 7-8μ.

This is placed here with considerable doubt, as the hyphae are quite different from those of any described species of *Scolecotrichum*, though the conidia appear to be typical. It is, perhaps, gererically distinct, but rather than to establish a new genus in this already overcrowded and confused group, we write it as above.

CLADOSPORIUM Lk.

C. Xyridis T. & E.

On Xyris fimbriata, Oeean Springs. Described in Bull. Torr. Club, Vol. 23, No. 5, as follows:

"Blackening the persistent withering petals. Mycelial threads effused, slender, not nodular, branching, occasionally septate, fuligenous, 3-4μ in diameter; conidia oval or somewhat fusiform, lighter colored than the mycelium, at length uniseptate, 7-10 by 4-5μ."

CLASTEROSPORIUM Schw.

C. curvatum (B. & C.) Sacc.

On Cratægus crus-galli, Starkville.

HELMINTHOSPORIUM Lk.

H. avenaceum Curt.

On Hordeum vulgare. Starkville.

H. geniculatum T. & E.

On Eragrostis rachitricha; grown from imported seed, Starkville. Described in Bull. Torr. Club, Vol. 23, No. 5, as follows:

"Blackening the spikelets. Hyphae thinly effused, flexuous, nodular, septate, dark fuscous, 100-125 by 4-5μ; conidia obtuse-fusiform, usually 4-septate, fuscous, central cell darker, apical cells lighter and nearly hyaline, usually abruptly geniculate on the enlarged central cell, 35-40 by 8-10μ."

H. spiculiforme E. & E.

On Sabal Adansonii, Bairds.

CERCOSPORA Fr.

C. Alabamensis Atks.

On Ipomoæ tamnifolia, Westside.

C. Bolleana (Thum.) Sacc.

On Ficus carica, Starkville.

C. Callicarpæ Cke.

On Callicarpa Americana, Biloxi, Ocean Springs and Starkville.

*__C. cercidicola__ Ell.

On Cercis Canadensis, Grenada.

C. clavata Cke.

On Gerardia quercifolia, Starkville.

*C. **consociata** Wint.

On Ruellia ciliosa, Ocean Springs.

C. **cornicola** T. & E.

On languishing leaves of Cornus florida, Ocean Springs. Described in Bull. Torr. Club, Vol. 23, No. 5, as follows:

"Epiphyllous, on irregular brown deadened spots without a definite border, 5-10 mm. Hyphae densely clustered from a nodular base, very short, continuous, somewhat flexuous, olivaceous, 11-15 by 3-4μ; conidia slender, thread-like, somewhat curved, mostly continuous, hyaline or light olivaceous, 60-70 by 2-3μ."

C. **Desmodii** (Thum.) Sacc.

On Desmodium linearis, Ocean Springs.

C. **Diospyri** Thum.

On Diospyrus Virginiana, Biloxi, Ocean Springs. Since the publication of Bulletin 34 we have had an opportunity to examine type specimens of C. Diospyri Thum., and of the var. ferruginea Atk., and we are forced to the conclusion that C. flexuosa T. & E. is not specially distinct from either. The three names seem to have been applied to different stages of growth of the same fungus. C. Diospyri was founded on immature specimens, where the hyphae were still short and continuous; C. flexuosa on specimens somewhat older, in which the hyphae are longer, sometimes branched, flexed, and frequently septate. Atkinson's specimen is fully matured and the conidia fully developed, being sometimes as many as 12-septate, dark-fuscous, and constricted. The gross appearance of the different forms is much the same, except that the fungus becomes darker colored as it approaches maturity.

*C. **Elephantopi** E. & E.

On Elephantopus Carolinianus, Biloxi and Durant.

*C. **fusco-virens** Sacc.

On Passiflora lutea, Durant.

C. **Glottidiicola** T. & E.

On ripening legumes of Glottidium Floridanum, with Macrosporium Floridanum, Ocean Springs. Described in Bull. Torr. Club, Vol. 23, No. 5, as follows:

"Forming greenish-black definite areas. Hyphae in small fasciculate clusters from a nodular base, 1-2-septate near the base, fuliginous, somewhat flexuous or geniculate, 50-70 by 5-6μ; conidia slender, clavate, hyaline, faintly 2-5-septate, 70-80 by 2-4μ."

C. **Hibisci** T. & E.

On Hibiscus esculentus, Biloxi and Ocean Springs.

C. **Ilicis** Ell.

On Ilex glabra, Ocean Springs.

C. **Ipomœæ** Wint.

On Ipomœa pandurata, Tupelo.

*C. **Liquidambaris** E. & E.

On Liquidambar styraciflua, Bairds, New Albany and Starkville.

*C. **Liriodendri** E. & E.

On Liriodendron tulipifera, Starkville.

C. **microsora** Sacc.

On Tilia Americana, Grenada and New Albany.

C. **minima** T. & E.

On Pyrus communis, Biloxi. Described in Bull. Torr. Club, Vol. 23, No. 5, as follows:

"Epiphyllous, on brown irregular indeterminate areas. Hyphae densely caespitose, very short, continuous, flexed and irregular, olivaceous, about 10-15 by 4μ; conidia thread-like, hyaline, faintly septate, 40-60 by 2μ."

*C. **Mississippiensis** T. & E.

On Smilax tamnifolia, Bairds and Ocean Springs.

C. **Moricola** Cke.

On Morus rubra, Starkville.

C. **Myricæ** T. & E.

On Myrica cerifera, var. media, Ocean Springs. Described in Bull. Torr. Club, Vol. 23, No. 5, as follows:

"Epiphyllous, on dark brown indeterminate areas. Hyphae densely caespitose from a common nodular base, flexuous, 1-2-septate, light fuscous, 30-40 by 3-4μ; conidia narrowly clavate, faintly several septate, hyaline, 100-125 by 3μ, occasionally 175μ long."

C. **nigricans** Cke.

On Cassia acutifolia, Ocean Springs and Starkville; C. occidentalis; Biloxi, Ocean Springs and Starkville.

*C. **olivacea** (B. & R.) Ell.

On Gleditschia triacanthos. Starkville.

C. **purpurea** Cke.

On Persea palustris, Ocean Springs.

C. **septatissima** T. & E.

On Verbena Caroliniana, Columbus. Described in Bull. Torr. Club, Vol. 23. No. 5, as follows:

"Amphigenous, at first forming dark olivaceous angular areas bounded by the veins, at length widely effused; hyphae densely caespitose, irregularly bent and flexed, dark fuscous, distictly many-septate, 40-60 by 5-6μ, the

septa usually only 4-6μ apart; conidia slender, clavate, faintly septate, hyaline, 50-60 by 3-5μ."

***C. sordida** Sacc.

On Tecoma radicans, New Albany.

C. Stylismæ T. & E.

On Stylisma humistrata, Columbus. Described in Bull. Torr. Club, Vol. 23, No. 5, as follows:

"Amphigenous, spots, 2-3 mm. wide, white, surrounded by a dark raised border; hyphae in small, slightly divergent clusters, nearly straight; fuscous-olivaceous, uniseptate near the base, 40-50 by 5-6μ; conidia clavate, hyaline, faintly 3-5-septate, 50-70 by 4-5μ."

C. Violæ Sacc.

On Viola Muhlenbergii, Starkville.

MACROSPORIUM Fr.

M. Floridanum Cke.

On legumes of Glottidium Floridanum, with *Cercospora Glottidiicola*, Ocean Springs.

FUSARIUM Lk.

***F. heterosporium** Nees.

On Paspalum dilatatum, Tupelo.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 39.

FEEDING FOR BEEF.

E. R. LLOYD AND J. S. MOORE.

AGRICULTURAL COLLEGE, MISS.

AUGUST, 1896.

The bulletins of the Station are sent free of charge to all farmers in Mississippi who apply for them.

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Feeding for Beef.

On November 21, 1895, the Station began a series of experiments in feeding steers for the production of beef, the special features of the work being the testing of the feeding values of shredded corn fodder, and of the "Jack Bean" (*Canavalia ensiformis*), and for comparing them with rations of ordinary hays and cottonseed meal.

Thirty of the steers used in the work were three and four-year-old "Texans," which had been shipped here in September and which had been in pasture, with an additional ration of two pounds of cottonseed meal daily, during the month preceding the beginning of our work. Like most Texas steers, these were very wild and pugnacious, and on October 21 and 22 all of them were dishorned. This work was quickly and easily performed by the use of a "Leavitt" clipper, which cut the horns smoothly and close to the head, except in a few instances where the horn was too large, and from half an inch to an inch was left. Pine tar was applied to the cut surfaces and the wounds on nearly all of the animals bled but little and began to heal at once. Four of the animals bled somewhat profusely, and the wounds became quite offensive within a few days, but in those cases a second application of tar a week after the cutting was the only treatment needed to induce prompt and thorough healing. The effect of removing the horns was all that was necessary to render the animals quiet and to prevent any fighting or crowding while in the

feeding pens. The average weight of these steers at the beginning of the feeding tests was 704.8 pounds, and they were in fair condition as to flesh.

The remaining twenty-eight steers were "natives," nearly all of them having more or less Jersey blood, and as they had been accustomed to pen feeding they were not dishorned. They were two and three years old, and their average weight was 445.4 pounds. The weights given for both lots are the averages of two weighings, made on the two days before commencing the tests. Weights given for other dates are the averages of the weighings made on the dates named and on the previous day.

The feeding was conducted in a stable having stanchions for fifty-eight animals. The building was divided into twelve sections and each section opened into an adjoining yard where there was an abundant supply of water and room for exercise. The stanchions were not used during the test, and the animals were allowed to go in and out of the stable at will.

The shredded corn fodder was made from a crop of "Mosby" corn which was cut and shocked in the field on August 26. At that time it was riper than it should have been to make the best of fodder, nearly all of the grain being hard, and many of the leaves dry. On September 23 the corn was husked and the shocks were again tied and were allowed to stand until September 30 when the fodder was run through a "St. Albans" shredder, which cut and tore the stalks in pieces so thoroughly as to put them into excellent mechanical condition, the shredded mass being as fine and soft as ordinary hay. The shredded material was run into a shed where it made a pile twenty feet wide and twelve feet high and where it was allowed to lie a month before baling. None of it was injured by heating or moulding.

The silage was from corn on which the lower leaves were somewhat yellowed when put into the silo, on July 30. The crabgrass hay was from a volunteer growth on land

from which oats and vetches had been cut, and contained very little of any other grass. It was cut on July 25. The red clover was from a field cut May 20, and had been well cured without rain. The peavine hay was cut October 1, the vines being of the "Speckled" variety. The Jack Bean used in the work is an East Indian bean which has been cultivated in the southern part of the state for some years, principally as a curiosity. The plant has something the appearance of an ordinary Lima bean, growing from two to three feet high, quite bushy, and yielding thirty to forty bushels per acre of large white beans. The Station has had the bean in cultivation five years, and as its yield has been very heavy, and its chemical analysis showed it to be very rich in protein and carbohydrates, it was hoped that it might prove to be of value for feeding purposes. Air dry samples of all the feeding stuffs were taken at the beginning and at frequent intervals during the work, and the average analyses of these samples, made by W. R. Perkins, Assistant Chemist of the Station, were as follows:

ANALYSES OF FEEDING STUFFS.

	Moisture.	Crude Fiber.	Crude Protein.	Ether Extr't	Nitro'n Free Ext.	Ash
Shredded Corn	8.40	36.09	3.97	1.00	46.00	4.54
Silage	83.51	4.67	1.19	0.47	9.05	1.31
Crabgrass Hay	10.70	26.77	8.59	3.66	41.49	8.79
Peavine Hay	8.71	18.90	21.56	6.34	34.85	9.64
Red Clover Hay	8.20	20.90	17.13	5.41	40.07	8.29
Cottonseed Meal	9.33	6.39	41.48	9.29	26.35	7.16
Jack Bean Meal	11.48	8.75	23.75	2.65	50.37	3.00

In the feeding, the hay for each lot was weighed out separately every morning and divided between the morning and evening feedings, each lot being given all it would eat. The grain ration was weighed separately for each feeding. Waste of both hay and grain was collected and weighed separately, daily, and the weight of the waste was deducted from the gross amount of feed given before making the following tables. Lots marked 1, 2, 3, 4, 5, and 6 were the Texas steers, while those marked 1a, 2a, 3a, 4a, 5a, and 6a were the natives, the proportions of the feeds given the two lots having corresponding numbers being the same.

Lots 5a and 6a had four steers each, all other lots having five each.

Feeding was commenced on the morning of November 21, and was continued until the morning of January 3, a period of 44 days. After feeding for a short time it was found that the shredded corn fodder was so dry that none of the lots was eating it well, and after the morning of December 11 a small amount of ensilage was mixed with the feed for each lot during the remainder of the test. The figures given below represent the actual amounts of food consumed, but all of the ensilage was fed during the last 23 days of the tests. Results were as follows:

Lot 1.

	lbs.
Av'ge amount food consumed: Shredded corn fodder	229.8
Silage	194.6
Cottonseed Meal	260.8
Average weight at beginning	726.0 lbs.
" " " close	768.4 "
" gain	42.4 "

Lot 1a.

	lbs.
Av'ge amount food consumed: Shredded corn fodder	183.8
Silage	186.8
Cottonseed Meal	222.7
Average weight at beginning	423.4 lbs.
" " " close	475.0 "
" gain	51.6 "

Lot 2.

	lbs.
Av'ge amount food consumed: Shredded corn fodder	291.8
Silage	194.6
Cottonseeed meal	82.2
Jack bean meal	137.8
Average weight at beginning	712.0 lbs.
" " " close	744.8 "
" gain	32.8 "

Lot 2a.

	lbs.
Av'ge amount food consumed: Shredded corn fodder	193.0
Silage	170.8
Cottonseed meal	67.7
Jack bean meal	116.2
Average weight at beginning	410.2 lbs.
" " " close	423.6 "
" gain	13.4 "

Lot 3.

Av'ge amount food consumed { Crabgrass hay.....494.4
Cottonseed meal.....238.1

Average weight at beginning.....681.0 lbs.
" " " close.....738.8 "
" gain..... 57.8 "

Lot 3a.

Av'ge amount food consumed { Crabgrass hay.....442.5
Cottonseed meal.....215.2

Average weight at beginning.....418.0 lbs.
" " " close.....498.6 "
" gain..... 80.6 "

Lot 4.

Av'ge amount food consumed { Crabgrass hay.....431.5
Cottonseed meal..... 73.2
Jack bean meal..... 71.6

Average weight at beginning.....703.6 lbs.
" " " close.....725.2 "
" gain..... 21.6 "

Lot 4a.

Av'ge amount food consumed { Crabgrass hay.....455.4
Cottonseed meal..... 71.4
Jack bean meal..... 92.7

Average weight at beginning.....485.6 lbs.
" " " close.....531.4 "
" gain..... 45.8 "

Lot 5.

Av'ge amount food consumed { Peavine hay.....425.2
Cottonseed meal.....253.9

Average weight at beginning.....681.6 lbs.
" " " close.....734.0 "
" gain..... 52.4 "

Lot 5a.

Av'ge amount food consumed { Peavine hay.....427.1
Cottonseed meal.....231.5

Average weight at beginning.....480.2 lbs.
" " " close.....548.2 "
" gain..... 68.0 "

Lot 6.

Av'ge amount food consumed { Red clover hay.....402.8 / Cottonseed meal.....253.7

Average weight at beginning.....724.4 lbs.
" " " close.....800.0 "
" gain..... 75.6 "

Lot 6a.

Av'ge amount food consumed { Red clover hay.....438.9 / Cottonseed meal.....222.4

Average weight at beginning.....455.2 lbs.
" " " close.....523.0 "
" gain..... 67.8 "

Lots 2 and 2a, fed with shredded corn and silage for hay and with bean and cottonseed meal for grain, made an average gain of only 46.2 pounds, while the check lots, 1 and 1a, having the same hay ration, but with pure cottonseed meal instead of part bean meal, made a gain of 92.0 pounds.

Lots 4 and 4a, fed with the mixed meal, gained only 67.4 pounds, while 3 and 3a, with the same hay and pure cottonseed meal, gained 138.4 pounds.

Lots 2, 2a, 4 and 4a, receiving bean meal, made an average gain of only 113.6 pounds, while the check lots, 1, 1a, 3 and 3a, with the same hays but with cottonseed meal, made a gain of 230.4 pounds. Three of the lots fed with bean meal made a smaller gain than did any of the lots receiving cottonseed meal, and the best of the bean meal lots, No. 4a, gained only 3.4 pounds more than did the poorest of the lots receiving cottonseed meal. It should be noted that the lots receiving bean meal were also fed cottonseed meal amounting to about one-third of their grain ration, and a large part of their small gain should doubtless be credited to the cottonseed meal and not to the bean meal.

The complete failure to secure profitable results from the use of the bean meal was a surprise and disappointment. Various methods of feeding were tried, both coarse and fine meal being used, and during a portion of the time the meal was cooked until it was thoroughly softened. At first very few of the steers would eat any of the meal, but were finally induced to do so by mixing it with salt and cottonseed meal, so that when the trial feedings began all

ate it fairly well, though not with much apparent relish. The meal which was eaten appeared to be very indigestible for all the animals, and the same was found to be the case when it was fed to milch cows, as will be shown in another bulletin, soon to be published.*

When tried on the table of one of our Station staff the beans were of fair quality, though rather coarse, and no one of the six persons who ate them experienced any ill effects from them.

Lots 1, 1a, 3 and 3a are comparable with 2, 2a, 4 and 4a to show the relative values of shredded corn fodder and silage as against crabgrass hay. Lots 1 and 1a, receiving shredded corn and silage, made a gain of 94 pounds, while lots 3 and 3a, with the same grain ration but with crabgrass hay in the place of the shredded corn and silage, made a gain of 138.4 pounds. Lots 2 and 2a, receiving shredded corn and silage, made a gain of 84.4 pounds, while lots 4 and 4a, with the same grain ration but with crabgrass in the place of shredded corn and silage, made a gain of only 67.4 pounds, which is the reverse of the results with the other lots. The whole of the four lots receiving shredded corn and silage made a gain of 178.4 pounds, while the four lots receiving crabgrass hay, with the same grain rations, made a gain of 205.8 pounds. The gross gain in this case is in favor of the crabgrass, but the lower cost of the shredded corn is an apparent compensation for this, though their actual relative values cannot be determined without further work.

Lots 5, 5a, 6 and 6a had the same grain rations, but different hays, 5 and 5a being fed with peavine, while 6 and 6a received red clover. The two lots receiving peavines made a gain of 120.4 pounds, while those receiving red clover gained 143.4 pounds, showing a decided advantage for the red clover hay.

If the different feeds are considered with reference to only single ingredients of the several rations, the average gains per steer were as follows:

Shredded corn and silage	35.1 lbs.
Crabgrass hay	51.5 "
Peavine hay	60.2 "
Red clover hay	71.7 "
Cottonseed meal	62.0 "
Bean meal	28.4 "

At the expiration of 44 days the hay feeds of lots 1, 2, 3 and 4, with their duplicates, was changed, the grain part of the ration remaining the same. This second period continued 12 days with the native steers and 32 days with the Texans, each lot being pronounced ready for market at the close of their terms of feeding.

With these changes of feeds lots 1 and 1a, which had made a gain of 1.07 pounds, made a daily gain of only .77 pounds when crabgrass hay was substituted for shredded corn and silage.

Lots 2 and 2a, which had made a daily gain of .53 pounds, made a daily gain of .48 pounds when crabgrass hay was substituted for shredded corn and silage.

Lots 3 and 3a, which had made a daily gain of 1.57 pounds, made a daily gain of 1.30 pounds when shredded corn and silage were substituted for crabgrass hay.

Lots 4 and 4a, which had made a daily gain of .77 pounds, made a daily gain of 1.02 pounds when shredded corn and silage were substituted for crabgrass hay.

If lots 1 and 2, with their duplicates, are taken together we find that during the first period, when they were fed with shredded corn and silage, they made an average daily gain of .80 pounds, and that the change to crabgrass hay reduced their gain to .63 pounds daily.

Lots 3 and 4, with their duplicates, which had made an average daily gain of 1.17 pounds when fed on crabgrass hay, made almost the same, 1.16 pounds, when shredded corn and silage were substituted for the hay.

Lots 5 and 6, with their duplicates, 5a and 6a, had no change of ration except that the cottonseed meal was increased to 7½ pounds daily, as it was desired to feed them with the heaviest possible grain ration for their finish. On the increased meal ration lots 5 and 5a which had made a daily gain of 1.37 pounds when receiving 5.5 pounds of meal increased their gain to 2.18 pounds daily. Lots 6 and 6a which had made a daily gain of 2.63 pounds when receiving 5.4 pounds of meal, decreased their gain to .98 pounds when their meal ration was increased to 7.5 pounds. This large increase in the meal ration was evidently greater than the animals were able to assimilate, though none of them showed any indications of scouring or other digestive trouble.

During the entire period of feeding lots 5 and 5a fed with peavine hay and cottonseed meal, made an average gain of 1.64 pounds daily, while lots 6 and 6a, fed with red clover hay and cottonseed meal, made an average gain of only 1.41 pounds daily. These figures seem to indicate that peavine hay is better for feeding purposes than is red clover, but it should be remembered that as long as the smaller meal ration was fed the clover lots made the greater gain, and that only when the grain part of the ration was increased to more than is usually considered safe did those receiving peavine hay make the greater gain. In fact, it is doubtful if the last feeding period should be considered in this connection, and if comparisons are to be made between the gain of the two lots they should be for only the first period, when the clover fed animals made a gain of 1.63 pounds daily, while those fed with peavine hay gained only 1.37 pounds when receiving the same grain ration, or 1.64 pounds if the time when they received the larger grain ration is included.

If the different feeds are considered with reference to only single ingredients of the several rations, the average gains per day were as follows:

Shredded corn and silage	.92 lbs.
Crabgrass hay	1.20 "
Peavine hay	1.64 "
Red clover hay	1.41 "
Cottonseed meal	1.44 "
Jack bean and cottonseed meal	.76 "

SUMMARY.

1. Shredded corn stalks need to have silage or some similar feed mixed with them to make them palatable.

2. Shredded corn stalks are inferior to either crabgrass, peavine, or red clover hay, though its less cost compensates for a part, or all, of the difference in feeding value.

3. Peavine hay is superior to either shredded corn or crabgrass, but not equal in feeding value to red clover hay.

4. The greatest gain, and the most profitable gain, was from feeding red clover hay.

5. Jack bean meal is not eaten with relish, and appears to be so indigestible as to be worthless.

6. Cottonseed meal was the cheapest, as well as the most effective grain ration used.

7. Five and one half pounds of cottonseed meal per steer per day was fed without injury, while seven and one half pounds was more than the steers could use to advantage.

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Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 40.

THE COW PEA.

S. M. TRACY AND E. R. LLOYD.

AGRICULTURAL COLLEGE, MISS.

DECEMBER, 1896.

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The Cow Pea.

THE COW PEA, like corn, wheat, and many other standard crops, is a plant of which we cannot be certain concerning its origin and early history. It is doubtless of Asiatic origin, though the original wild type has never been identified. DeCandolle, in his "Origin of Cultivated Plants," states that it has been in cultivation at least three thousand years, and many varieties were in cultivation in England in 1776. We have no record of its introduction into the United States, but as it was quite common at the beginning of the present century, it was probably brought here from England by some of the earliest settlers of the country. Like corn, it varies greatly with different soils and climates, and our present cultivated varieties are so different from each other, and from any known wild forms, that it is impossible to state with certainty what are its botanical relationships, or, indeed, whether all our varieties belong to one or more species. A number of technical names have been given to our cultivated varieties indiscriminately, of which the one accepted by the United States Department of Agriculture, *Vigna sinensis*, is probably the best. Whether all our cultivated varieties have sprung from a single source, or have resulted from the crossing and hybridizing of four our five distinct species matters but little to the cultivator

who desires simply a plant which will make good hay or pasture, and at the same time will soften, fertilize, and improve his soil, and what we have to say here concerning varieties applies only to the forms which are now found on the plantations without regard to their far-away origin.

PLANTING.

Whether peas should be sowed broadcast or in drills, should be decided by the object for which the crop is to be grown, the time when it is sowed, and the relative prices of seed and labor. In growing the crop for hay we have found the following method the most satisfactory. The ground is plowed broadcast, and harrowed immediately before the seed is sowed. We use an ordinary corn planter for sowing, putting the drills from two and a half to three feet apart, the greater distance being given on the richer soil. The sowing is done on a level, without any ridging, as is the more rational method on all well-drained soils, both for protecting the crop from injury in time of drouth, and to leave the ground smooth for the mowing machine. The crop is cultivated twice or three times with a five-toothed cultivator which runs very shallow, but breaks the crust between the rows so as to keep the plants in a thrifty and growing condition. No hoeing is required, as the crabgrass which grows in the drills is so soon shaded by the growing vines as to be entirely harmless, and the little which grows adds so much to the yield of hay. Drilling has the advantage of requiring very much less seed, it affords an opportunity to secure an increased growth by cultivation, and makes the crop much easier to cut for hay. Our experience has been that the increase in yield, of both seed and hay, has more than compensated for the additional expense in drilling and cultivating the crop.

When sown broadcast less labor is needed in the work, and the crop requires no further attention in the way of cultivation. The vines soon cover and shade the ground, and the crop costs absolutely nothing except for the seed, sowing, and the use of the land. More seed is required than when sowed in drills, the growth of the plants is less vigorous, and the crop is not as easily cut if wanted for hay. When seed is cheap and labor is scarce broadcasting is the more common plan, especially when

the seeding can be done early in the season. The cost of the seed for broadcasting is several times more than for drilling, from one to two bushels per acre being used, the smaller amount for the running varieties when planted early, and the larger amount for the more erect varieties when planted late. When planted in drills from six to sixteen quarts will seed an acre.

VARIETIES FOR SPECIAL PURPOSES.

The selection of the variety for planting should be determined by the use for which the crop is designed. If a heavy yield of hay is the principal object, the more vigorous and late maturing upright varieties, such as Clay, Unknown, and Whipporwill, should be used. Of these the Unknown is certainly one of the best, but if to be cut for hay should not be planted too early, as it finally becomes so trailing as to be difficult to cut with a machine, and it produces less seed when it has too long a season for growth.

If the crop is to be pastured, or is to be left to decay through the winter on the surface of the ground, trailing varieties should be used; the Unknown, Black, and Red Ripper being among the best. For this purpose they should be planted as early as possible.

For stock peas, Black, Clay, Speckled Crowder, and Unknown have given us the heaviest yields; but if peas are wanted for table use, the Large and Small Lady, Sugar, and Blackeye, will be among the best.

One of the common methods of growing peavines is to plant them between the rows of corn at the time of giving the last cultivation. In this way a crop is secured which costs absolutely nothing except for the seed and sowing, and which may be relied upon for a considerable amount of seed and grazing, and at the same time will make a cheap and effective fertilizer for the succeeding crop. In some cases the peas and corn have been planted at the same time, in alternate hills, but we have rarely found the practice economical. If running varieties are used they tie cornstalks together so as to materially reduce the yield of the grain, while if dwarf varieties are used they are so shaded by the corn as to make but little growth. When planted between the rows in June or July

they begin their most rapid growth after the corn begins to ripen, and the corn crop is gathered before the vines are large enough to be troublesome. When a crop of peas is grown in this way it cannot well be cut for hay, but will usually make a good yield of seed, and will afford a large amount of most excellent grazing for either cattle or hogs. For such late grazing the Black and the Red Ripper are among the best varieties, as the peas will lie on the ground a long time without injury.

FERTILIZING.

Although cow peas are grown principally for their fertilizing effect on the soil, and are among the best of nitrogen collectors, there is no crop which will respond more quickly to an application of fertilizer, and no crop on which it pays better to use fertilizers, The special value of the cow pea as a fertilizer is its power to assimilate nitrogen, the most expensive element of fertility, from the air. An increased growth of vines means a corresponding increase in the storing of nitrogen, as well as an increased crop for harvesting, and an increased amount of vegetable matter left in the soil, which are worth far more than the cost of the fertilizer necessary to produce the increase. When the vines are plowed under, or are left to decay on the surface of the ground, nearly or quite all of the fertilizing material consumed in their growth is left in the soil in the best possible condition for succeeding crops, and any trifling loss of phosphoric acid and potash which may occur through leaching will be more than balanced by the greater availability of that which was already in the soil. The fertilizer applied to the pea crop is not lost, but remains in the soil ready for the succeeding crop. The growth of a crop of peavines is a very sure indication of what may be expected from the succeeding crop, and any fertilizer which will increase the growth and vigor of the peavines will be still more effective in forwarding the growth of whatever may follow them, as the vines leave the soil in a much better condition than when they were planted.

The best fertilizer to apply depends on the character of the soil where the crop is to be grown. Vegetable matter is as essential to the growth of peas as to any other crop, and they will not make a satisfactory growth

on soil which is too hard and barren to make a fair growth of lespedeza. On such soils no fertilizer is so effective as stable manure, and when that cannot be had cotton seed is the best substitute. Whichever may be used should be plowed under before the peas are planted, so as to loosen and lighten the heavy soil as much as possible. On very light soils cottonseed meal is better than the seed, and should be used as a top dressing at the rate of 150 or 200 pounds per acre at about the same time when the peas make their second pair of leaves. On soils which contain even a moderate amount of vegetable matter manuring before planting is not essential, but a light top dressing of meal applied when the nourishment in the seed has been exhausted and before the plants are large enough to assimilate nitrogen from the air will always pay. On soils which are in "good condition" we have found it profitable to fertilize highly, though small applications of acid phosphate, 100 to 150 pounds per acre, have usually given a heavier crop of seed than has been secured without. Potash has rarely been profitable.

DISPOSITION OF THE CROP.

Whether peavines should be used for making hay, for pasture, or for plowing under as green manure, must depend upon the condition of the field in which they are grown. If the field is in fairly good condition it will usually be more profitable to make hay of them than to use them in any other way. The roots, and the leaves which drop from the vines, will, on all soils which are in good condition, be sufficient to still further improve their condition, and will furnish a sufficient supply of nitrogenous matter for the succeeding crop. Such a soil will yield at least two tons of hay per acre, and at the same time its supply of plant food available for succeeding crops will be greatly increased, so that the plowing under of the whole vines will be at a loss. In the weighings which we have made we have found the weight of the roots in the upper foot of the soil to be from one-fourth to one-third the weight of the vines. It is impossible to give the exact weight of the leaves which drop from the vines during growth, or of the stems and other parts of the plants which are left on the ground in making hay, but as the leaves are richer in nitrogen than is any other part of the

plant excepting the seed, they certainly add very largely to the fertilizing value of the crop.

The Louisiana Station (Bulletin 40) found the weight of the roots to be about one-third that of the vines, the proportion being about one-fifth in the running varieties, while some of the bunch varieties showed equal weights of roots and vines. Similar weighings have been made at other stations, with similar variations.

Chemical analyses show the roots to contain a smaller percentage of phosphoric acid and nitrogen and a larger percentage of potash than is found in the vines. In the work done at this station we have found the composition of vines and roots to be as follows:

	Phosphoric Acid, per ct.	Potash, per ct.	Nitrogen, per ct.
Vines	.55	.75	2.32
Roots	.44	1.01	1.59

By these analyses, when a crop of two tons of hay is removed from an acre of land there is left 5.87 pounds of phosphoric acid, 13.47 pounds of potash and 21.31 pounds of nitrogen in the roots alone. As these analyses of the roots include the roots only, and not the leaves and other parts of the vines always left on the ground in making hay, the amounts of all the elements, especially of the nitrogen, which are left as fertilizing material are much too small.

Including the roots, the leaves which are dropped during growth, and the various losses which occur in harvesting, it is certainly safe to estimate the weight of the material usually left in the field as being not less than one-third the amount carried away, and in many cases the amount of vegetable matter left to decay in and on the soil is fully equal to that carried away as hay. Such an amount of green manure is ample for any soil which will produce two tons of dry hay per acre.

On poorer soils, where the yield of vines is light, it is often better to use the entire crop as a fertilizer, but the manner in which it should be used should be determined by the physical condition of the soil. If the soil is a heavy clay which needs to be made lighter and looser we have found it better to plow the vines under while green as they are then more effective in their aerating and mellowing action. If the vines are so heavy as to tangle and

make plowing difficult they should be grazed a few days previous to the plowing, but no longer than is necessary to enable the plow to cover what remains. One of the main objects of the work is to incorporate the green vegetable matter with the soil for its mechanical effect, and the plowing should be made to bury as much bulk of vines as is possible.

If the soil is sandy, and already too light, green vines should never be plowed under, but should be grazed or left to decay on the surface. When the vines are grazed the tramping of the stock improves the condition of the light soil, and the droppings of the animals will contain very nearly the same fertilizing elements originally in the peavines, so very little is carried from the field. Such a field should be grazed if possible, but if it cannot be pastured, the vines should be allowed to decay on the surface of the ground so as to protect the field from washing during the winter. When the vines are plowed under while fresh we have found it better to do the work not later than October, and then to sow oats for covering the ground during winter. If grazed, or plowed under early in the spring, the oat crop removes nothing permanently from the soil, and all the fertility made available by the pea crop will again be available after the decay of the oats.

The cow pea is one of the few crops which will yield an abundant crop of valuable hay and at the same time leave the soil on which it grew in an improved chemical and mechanical condition for a succeeding crop. It is the best "catch crop" which can be grown for hay, and is, by far, the best crop which can be grown on land from which wheat, oats, or other early crops have been harvested. In cultivating for hay it is important to select varieties which will be in a condition for cutting early in October, as that gives the whole of the growing season for the production of a heavy crop and brings the harvesting in the month when there is the least rain. If the crop is to have a long season for its growth, we prefer late ripening sorts, like the Black, Speckled Crowder, or Unknown; while if the planting is done late in the season we have secured better results by the use of early varieties like the Red Crowder or the Whipporwill. The value of the hay increases very rapidly as the crop approaches maturity, while if allowed to become over ripe many of the leaves

drop and are lost, more or less of the seed will be shattered out and lost, and the hay secured is more hard and woody then when cut at the proper season. The best stage for cutting peavines for hay is when the first pods begin to ripen. When cut at that stage the vines cure much more easily and rapidly than when cut earlier, the total yield is at its heaviest, and, though the hay may not be quite so tender as when cut earlier, it will be eaten well and will have added much to its nutritive value.

Although the hay is regarded as somewhat difficult to cure, it is not so when cut at the proper stage of maturity and handled with care. We have saved five successive crops without the loss of a pound from mould or heating in the field or in the barn, by the following method. The mower is started in the morning as soon as the dew is off, and run until noon, or until as much has been cut as can be handled in the afternoon. As soon as the top of the cut vines is well wilted the field is run over with a tedder to turn the vines over and expose them more thoroughly to the air and run. When the crop is very heavy the tedder is used a second time, though this is seldom necessary. Vines which have been cut in the morning and teddered in the afternoon are usually dry enough to put into small cocks the next afternoon, and if the weather promises to be favorable they are left to remain in the cocks two or three days before they are hauled to the barn. If it should rain before the vines are put in cocks they are not touched until the surface is well dried off, and then teddered as though freshly cut. Those which are in cocks are not opened until well dried on the outside, and are then handled as little as is possible to secure a thorough airing. A light rain does very little damage to the hay, even after the curing has begun, if handled promptly and properly, and a heavy rain for a day or two may fall on freshly cut vines and do little or no damage. The essential point in making the hay is to do the work as rapidly as possible, and to avoid any handling of the vines when wet with either dew or rain. We find that it pays well to use a tedder for stirring up the freshly cut vines so as to admit sun and air freely, though if a tedder cannot be had the work can be done nearly as well, though more slowly, by using a fork.

It is not safe to bale the vines direct from the field. Of course that is the most convenient plan, but, as in many other cases, the quickest way is not the best. Al-

It is not safe to bale the vines direct from the field. Of course that is the most convenient plan, but, as in many other cases, the quickest way is not the best. Although the field cured hay may appear and feel perfectly dry, it still contains a considerable amount of moisture, and if packed closely at once, it is sure to undergo a heating and fermentation, the escape of the heat and moisture is prevented, and decay is the result. We find the only safe plan is to put the hay, for a few week, sinto a stack covered with straw, or still better into a barn where it should not be piled too deep. After a month it may be packed without danger of finding mouldy or dusty hay in the centers of the bales.

The quality of peavine hay compares favorably with that from red clover or any other leguminous plant, and is even richer in protein than are many of the common grain feeds. Jenkins and Wilton (Experiment Station Bulletin No. 11) give the averages of a large number of analyses as follows:

	Protein.	Carbo-hydrates.	Fat.
Cowpea	16.6	47.7	2.4
Red Clover	12.3	38.1	3.3
Timothy	5.9	45.0	2.5
Corn	10.3	70,4	5.0
Oats	11.8	59.7	5.0
Wheat Bran	15.4	53.9	4.0

The approximate feeding values of these materials per ton, as calculated by the Connecticutt Experiment Station, are as follows:

Cowpeas	$12.60
Red Clover	11.20
Timothy	10.48
Corn	17.72
Oats	16.72
Wheat Bran	13.76

These figures make the values of the different crops, per acre, as follows:

Cowpeas, two tons,	$25.20
Red Clover, two tons	22.40
Timothy, two tons	20.96
Corn, fifty bushels	24.80
Oats, forty bushels	10.71

Of course the cash valuations given above are only approximations, as they are based on the average market prices for the different feeds during a series of years, while the actual farm values will vary with the yields in different seasons, and with the local market.

SAVING SEED.

When the peavines are grown in the cornfield, or allowed to become over ripe before they are grazed, or the vines are to be left to decay on the ground it is usually more profitable to gather the seed than to leave it for its fertilizing effect. The yield is extremely variable, being sometimes almost nothing, while in other cases as much as forty bushels per acre have been secured. As ordinarily grown and gathered the yield probably does not average more than twenty bushels per acre. As the pods do not split open until long after they are matured, picking may be delayed until nearly all of the crop is ripe. After they are gathered the pods should be sunned until thoroughly dried, after which they may be stored in a dry place until wanted for planting, or may be threshed at once. Many prefer the former plan, as, when left in the pods the seed suffer less from weevils than when threshed and exposed. When kept in the pods they are bulky, and the pods do not afford a sure protection from insects, so we prefer to thresh as soon as the pods are well dried. We have never found any machine for threshing them which has been satisfactory, and so have been obliged to beat them out with flails. The man who will place on the market a cheap and effective pea thresher will not only have the thanks of every southern farmer, but will find that he has made an extremely profitable investment. After threshing, the peas are put in barrels, about two ounces of bisulphide of carbon is poured into each barrel, and the top covered with old sacks. This treatment will ordinarily be all that is necessary to prevent attacks from weevils or other insects, though when we have kept peas for very late planting we have sometimes found a second application of the bisulphide was needed in the spring. This treatment does not injure the peas, either for planting or for eating.

CLASSIFICATION OF VARITIES.

Of the so-called varities of cow peas there are an almost infinite number, though, as with corn and cotton, there are very few really distinct and permanent types. This Station has had more than fifty named sorts in cultivation; in 1895 the Louisiana Station cultivated sixty-three varieties; in 1895 the Georgia Station tested forty-seven varieties; while the Arkansas, Texas and other Southern Stations have also tested a very large number of sorts. In all these long lists of varieties there are very few forms described which can not be easily referred to some one of four or five types. In color of seed we have white, black, red, and cream colored, plain, and in almost every possible combination of colors. The flowers vary from white to yellow and purple, and the color of the flower gives no indication of the color of the seed. The seeds vary in shape from nearly spherical to kidney shaped, and in size some are fully three times as large as others.

No cultivated plant varies more quickly than does the cow pea, and with a little care in selection, a large number of forms may be produced within a very short time. In 1894 one plant was noticed in a field of the common "Clay" pea which produced dark colored seeds with a light eye. A few seeds from this were planted in 1895, when the product from this single plant showed colors ranging from light cream to dull red and black, though all the plants had the same general habit of growth. If the color of the seed only were to be considered, we had almost as many varieties as plants. While this was an extreme case, still few planters have failed to notice the great differences in the color of the seed as well as in the growth of the plants in different parts of the field, when any of the well marked varieties have been planted on different soils, or at different seasons. There are several varieties which, if planted in April, will grow through the whole season, making long and trailing vines which produce very little seed, while if the planting is not done until July will make a strong, erect growth and abundant crop of seed. Similar changes are brought about by change of latitude, and the time required for maturing a crop of cow peas varies almost as much as that required

for a crop of corn. Varieties which have been grown in the extreme South for many generations tend to ripen later, and to make a heavier growth of vines, while if gradually removed to more northern latitudes and shorter seasons they become acclimated, grow to only a moderate size, and mature more quickly.

In every locality where the cow pea is grown there are varieties which are well known under certain names, but many of these names are entirely unknown in other localities. A few names, like "Unknown," "Whipporwill," and "Red Ripper" are known everywhere, while others like "Smith," "Colvin," and "Williams Hybrid" are unknown outside the localities where they originated, and in most cases are simply new names given to some of the older sorts. In some cases single varieties have received two or more names, and among those which have been cultivated here under different names, but which appear to be the same are "Speckeled" and "Whippoorwill," "Quadroon," "Wonderful," and "Unknown," "Gourd," "Matthews," and "Polecat," "Everlasting," and "Red Ripper," "Small Red" and "Tory," "Everlasting" and "Torg," "Mush" and "Rice."

Confusion in names has also been increased by the application of the same name to varieties which are quite distinct, as is the case with the names "Everlasting," "Green," "Red Ripper," and others. The name "Crowder" is applied to almost any variety having a rather short and closely filled pod.

With plants which vary so readily with every change in their surroundings it is useless to give lengthy descriptions of all the many named forms, but they may be grouped conveniently as follows, very much as is done by Dr. Redding in Bulletin No. 26, of the Georgia Station:

1. Form of Pea.

(*a*) Spherical. Most varieties having spherical seeds are what are termed "Crowders," *i. e.* the seeds are packed very closely in the rather short pods. The common varieties in this group are Green, Purple Hull, Red Crowder, Small Lady, Speckeled Crowder, Sugar, White Crowder, and Williams.

(*b*) Kidney Shaped. This group includes all varieties except those which are grouped as "Spherical."

2. Color of Peas.

(*a*) White. Blackeye, Bluehull, Browneye, Conch, Green, Large Lady, Large White, Pony, Purplehull, Redeye, Rice, Small Lady, Small White, Sugar, Taylor, Vacuum, White, White Brownhull, White Crowder, White Giant.

(*b*) Buff or Cream. Clay, Everlasting, Green, Unknown.

(*c*) Pink and Red. Colvin, Flat Red, Large Red, Pale Red, Purplehull, Red, Red Crowder, Redding, Red Ripper, Red Yellowhull, Small Red, Tory.

(*d*) Mottled and Speckeled. Black and White, Calico, Chocolate, Coffee, Gourd, Granite, Indian, King, Lilac Redpod, Matthews, New Era, Redpod, Saddleback, Speckeled Crowder, White and Brown, Williams.

(*e*) Black. Black, Constitution, Congo, Shinny.

3. Size of Peas.

(*a*) Large. Bluehull, Calico, Coffee, Congo, Gourd, Granite, Indian, King. Large Blackeye, Large Red, Large White, Lilac Redpod, Matthews, Red Ripper, Red Yellowhull, Speckeled Crowder, Vacuum, White Crowder.

(*b*) Medium. Black, Blackeye, Browneye, Chocolate, Clay, Conch. Green, Large Lady. New Era, Pea of Backwoods, Pony, Purplehull Crowder. Quadroon, Red, Red Crowder, Redeye, Redpod, Shinny, Taylor, Unknown, White and Brown, White Brownhull, Whippoorwill, Williams, Wonderful.

(*c*) Small. Black and White, Bluehull, Colvin, Constitution, Everlasting, Flat Red, Green, Pale Red, Redding, Rice, Saddleback, Shrimp, Small Lady, Sugar, White.

4. Habit of Growth.

Any grouping of varieties which is based on habit of growth must be almost wholly arbitrary, as the whole character of growth and fruiting may be entirely changed by early or late planting, and by planting on different soils. In the list given below we have endeavored to group the varieties as we have found them when planted in May and June, on upland soil of medium fertility.

(*a*) Trailing. Black, Black and White, Coffee, Conch, Everlasting, Large Red, Large White, Redeye, Tory, Williams.

(*b*) Half Trailing. Bluehull, Calico, Chocolate, Coffee, Congo, Constitution, Granite, Gourd, Large Lady, Lilac Redpod, Matthews, New Era, Pony, Purplehull Crowder, Redding, Red Ripper, Red Yellowpod, Rice, Shinny, Shrimp, Sugar, Taylor, Vacuum, White, White Brownhull, Williams.

(*c*) Erect. Blackeye, Browneye, Clay, Coffee, Flat Red, Green, Pale Red, Red, Red Crowder, Speckeled Crowder, Unknown, Whippoorwill, Wonderful.

When planted early, and on rich soil, nearly all of the varieties grouped as "Erect," assume, late in the season, more or less of a trailing habit, and so might be included in group (*b*), but when planted late, or on thin soil, they remain bushy and erect.

5. Time of Maturity.

(*a*) Early. Black and White, Bluehull, Browneye, Chocolate, Coffee, Congo, Granite, Green, King, Large White, New Era, Red Crowder, Redeye, Red Yellowpod, Rice, Saddlebach, Whippoorwill.

(*b*) Medium. Blackeye, Clay, Coffee, Green, Indian, Large Lady, Lilac, Redpod, Pony, Rice, Small Lady, White, White and Brown, White Brownhull.

(*c*) Late. Black, Bluehull, Calico, Clay, Conch, Everlasting, Flat Red, Gourd, Matthews, Pale Red, Purplehull Crowder, Quadroon, Red, Redding, Red Ripper, Rice, Shinny, Shrimp, Small Red, Speckeled Crowder, Sugar, Taylor, Unknown, White Crowder, Williams, Wonderful.

Although we have made a great number of tests of varieties, the work extending through eight years, the results have been so variable and have been so plainly influenced by differences in soil and time of planting that it would be useless to give the details in full, and so summarize as above.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

BULLETIN NO. 41.

THE COLORADO POTATO BEETLE IN MISSISSIPPI.

HOWARD EVARTS WEED.

AGRICULTURAL COLLEGE, MISS.

MARCH, 1897.

The bulletins of the Station are sent free of charge to all farmers in Mississippi who apply for them.

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The Colorado Potato Beetle in Mississippi.

(*Doryphora 10-lineata.*)

For several years past the Station has received frequent inquiries regarding this insect and specimens of it from localities in the northern portion of the state, and from year to year it was noticed that the inquiries came from localities further south than those which had been previously received. Last year many more inquiries regarding the insect were received than ever before, and in fact nearly one-third of the inquiries sent to the Station relating to insects were in regard to this species, in many cases several being received from different persons in the same locality. As this insect is as new to many of the farmers of this state as it was to the farmers of Illinois and adjacent states in the early sixties, this bulletin has been prepared.

HISTORY AND DISTRIBUTION.

The Colorado potato beetle receives its common name from the fact that its native home was at the eastern base of the Rocky Mountains, where it fed upon a species of wild potato quite common to this region, known as the Sand-bur (*Solanum rostratum*). It was collected there and described by Thomas Say in 1824. It was first mentioned as an injurious insect in 1859 when some of the early settlers of Western Nebraska reported it feeding in large numbers upon the Irish potato. We thus see that the species changed its food from a wild to a cultivated plant, as has been the case with many of our injurious insects.

From western Nebraska in 1859, the species travelled eastward from year to year at the rate of about eighty miles a year. Iowa and Missouri were first invaded, Illinois and the states east of it soon afterwards, and it finally reached the Atlantic coast in 1874. Here the ocean stopped its progress eastward, and although for a time it was feared that it would soon appear in Europe, and specimens were even reported as having been collected in various European localities, yet it does not occur in Europe at present, nor is it known, according to Dr. Howard, in any foreign country.

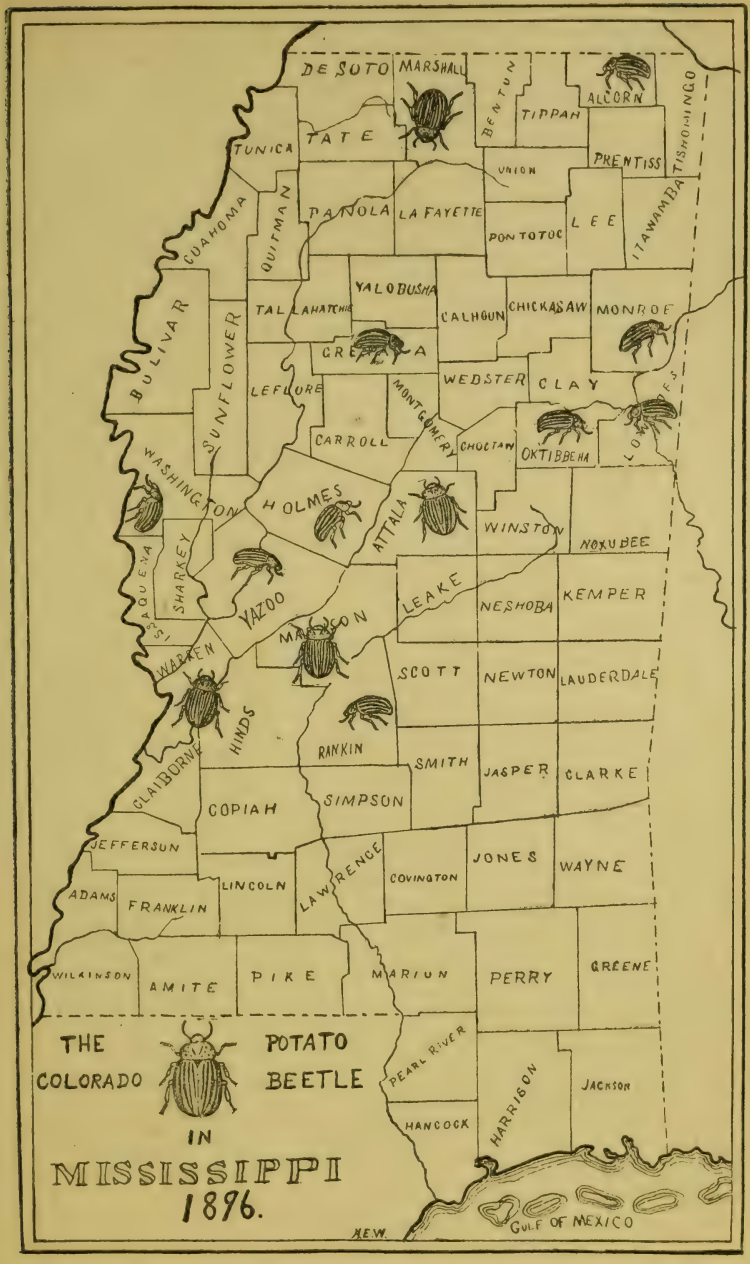
In the United States at present it occurs in injurious numbers in all the northern states east of the Rocky Mountains and as far south as a line drawn from Fort Worth, Texas, to Savannah, Georgia. Prof. Morgan of the Louisiana Experiment Station reports it as occuring slightly south of this line in that state. In 1875 the species did not occur in any localities south of the northern boundry of Tennessee and its spread southward has been rather slow, doubtless owing to two causes: (1) the natural home of the species being a colder climate, and (2) but few Irish potatoes having been heretofore grown in the south.

DISTRIBUTION IN MISSISSIPPI.

Near the northern border of Mississippi the species has been known for the past five years, and last year was found throughout the northern and central portions of the state. The accompanying map shows the localities in this state from which the insect was reported to the Station as occuring in injurious numbers last year. The species was reported in small numbers in other localities, and doubtless occured all through the northern portion of the state, but was not reported to the Station. Owing to the large increase in the acreage devoted to Irish potato growing in this state and throughout the South, it is probable that the species will continue its southward spread to the Gulf of Mexico.

DESCRIPTION AND LIFE-HISTORY.

While it is needless to describe in detail the appearance of an insect so well known to many farmers of the state, yet the following facts are given for the benefit of those who are not so familiar with the Colorado potato beetle. The mature insects make their appearance in the spring at about the time the potatoes are up, and lay their reddish eggs (*a* Fig. 1) upon the underside of the leaves.


DE SOTO
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LAFAYETTE
PONTOTOC
LEE
ITAWAMBA
BOLIVAR
SUNFLOWER
TALLAHATCHIE
YALOBUSHA
CALHOUN
CHICKASAW
MONROE
GRENADA
LEFLORE
WEBSTER
CLAY
MONTGOMERY
CARROLL
CHOCTAW
OKTIBBEHA
WASHINGTON
HOLMES
ATTALA
WINSTON
NOXUBEE
SHARKEY
YAZOO
LEAKE
NESHOBA
KEMPER
MADISON
WARREN
SCOTT
NEWTON
LAUDERDALE
HINDS
RANKIN
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
LINCOLN
LAWRENCE
COVINGTON
JONES
WAYNE
ADAMS
FRANKLIN
WILKINSON
AMITE
PIKE
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PERRY
GREENE
PEARL RIVER
HARRISON
JACKSON
HANCOCK
THE COLORADO POTATO BEETLE IN MISSISSIPPI 1896.
GULF OF MEXICO

The eggs are laid in clusters of from ten to forty and, according to Riley, the females have been known to dig into the ground before the potatoes are up in order to lay

FIG. 1.—COLORADO POTATO BEETLE.

aa, eggs; *bb*, larvæ; *c*, pupa; *dd*, beetle; *e*, wing of beetle, enlarged. (From Riley.)

their eggs. A single female usually lays about 500 eggs and in some cases twice that number. In a few days the eggs hatch into soft dark red larvæ (*b* Fig. 1) which soon become lighter in color with a double row of black spots along each side of the body, the legs and head being black. They feed upon the leaves and in from two to three weeks become full grown when they form pupæ (*c* Fig. 1) in the earth near the plant. In about ten days they come forth as perfect beetles as shown at *d* in Fig. 1, *e* showing the right wing case or elytra of a beetle, much enlarged.

DESTRUCTIVENESS.

Both the beetles and the larvæ feed upon the potato leaves, and unless some means are taken to destroy them, will soon devour every leaf. For several years before the general use of Paris green and other insecticides for the destruction of this insect, its ravages largely affected the market price of potatoes, in 1873 the wholesale price in the St. Louis market being, according to Riley, two dollars per bushel. But while the beetle has been and is very destructive, its occurance in the United States has not been altogether a curse, for to its ravages we very largely owe the introduction and extended use of insecticides. Soon after it was found that the beetles could be killed by the application of various poisonous substances,

attention was given to the use of these substances for the destruction of other insects. Experiments were made regarding the effect of many substances upon different injurious insects, and through these experiments and the improvements in the apparatus for the application of these poisonous materials which followed, the modern methods of combating our injurious insects have been developed.

THE BOGUS POTATO BEETLE.

A beetle very similar to the Colorado potato beetle known as the bogus potato beetle is shown in Fig. 2 and this should not be mistaken for the former. The wing cases of the two beetles differ as may be seen from the figures, the third and fourth dark stripe, counting from the outside, of the Colorado potato beetle are united behind, while in the bogus potato beetle, it is the second and fourth dark stripe from the outside which are united. The larvæ of the bogus beetle have but one row of dark spots on each side of the body, while the larvæ of the Colorado beetle have a double row of spots. The bogus beetles, however, never occur upon potatoes but are not uncommon upon the horse nettle (*Solanum carolinense*), a plant quite common in this state. The Colorado potato beetle will also feed upon the horse nettle as well as many other plants, especially tomato, upon which it even occasionally occurs in injurious numbers.

FIG. 2.—THE BOGUS POTATO BEETLE.

aa, eggs; *bb*, larvæ; *c*, beetle; *d*, wing, and *e* leg of beetle, enlarged. (From Riley.)

REMEDIES.

As both the mature insects and the larvae feed upon the potato leaves, they are easily killed by the application of any poison, and as the leaves are rather rough anything applied to them is retained much longer than upon leaves having a smooth surface. Of the many substances used for the destruction of these insects, Paris green in some form is the standard. It may be applied in the form of a spray by mixing with water at the rate of a teaspoonful of the green to a bucket of water, or in a dry form mixed with flour or lime. A common practice is to

mix the green with lime and water to the consistency of a thin paste and apply with a whitewash brush.

London purple is cheaper than Paris green and will do equally as well. Slug shot and other special preparations, most of which are effective in destroying this pest,

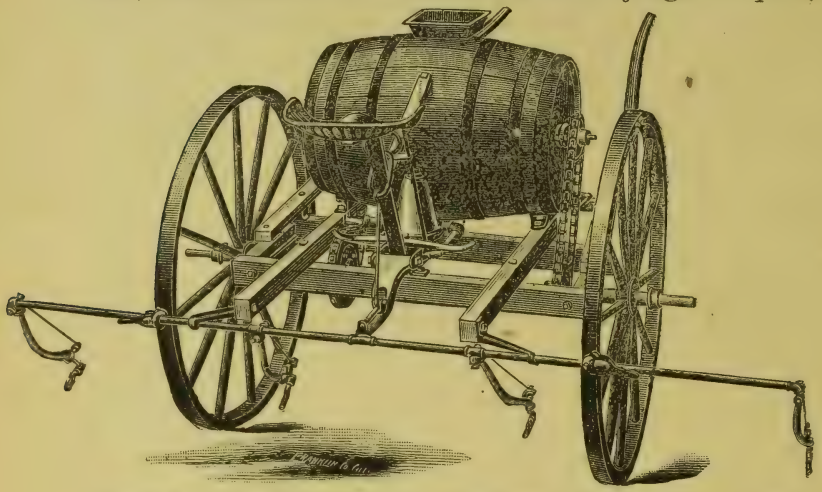

FIG. 3.—THE ASPINWALL POTATO SPRAYER. (From the manufacturers.)

have been upon the market for several years. In fact there is perhaps no injurious insect that is more easily combatted than the Colorado potato beetle. If the insecticide is applied in the form of a spray, the knapsack pump is a convenient apparatus with which to make the application. Where potatoes are grown upon an extensive scale, however, a larger form of apparatus such as is shown in Fig. 3 is necessary. When the insecticide is applied in a dry form, a common flour sack, some form of powder bellows, or a seive-like apparatus, such as shown in Fig. 4, may be used.

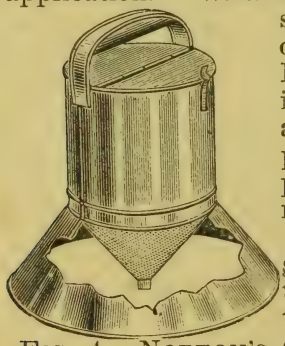

FIG. 4.—NORTON'S PLANT DUSTER. (From the manufacturers)

Treatment, however, should begin as early as the beetles make their appearance, for if the beetles that first appear in the spring are destroyed, no further damage will result.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

Bulletin No. 42.

Acclimation Fever, or Texas Fever.

AGRICULTURAL COLLEGE, MISS.,
NOVEMBER, 1897.

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Address all communications to **Agricultural Experiment Station,** Agricultural College ,Miss.

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Acclimation Fever, or Texas Fever.

J. C. ROBERT, V. M. D.

Stock raising is such an important industry that most other branches of agriculture are dependent upon or directly connected with it. The mild climate, fertile soil, and luxuriant grass crops of Mississippi make stock raising here attended by less expense than is found in the average Northern State. Before we can compete successfully, however, with the Northern stockbreeder, we must procure, as the nucleus of our herd, those animals especially adapted to our purposes.

The fact that often from fifty to seventy-five per cent of the cattle brought from the North to the South die of Texas fever is the greatest difficulty in the way of such improvement. The disease is also responsible for the fact that southern cattle must be sold, for most of the year, in Northern markets, under certain quarantine restrictions.

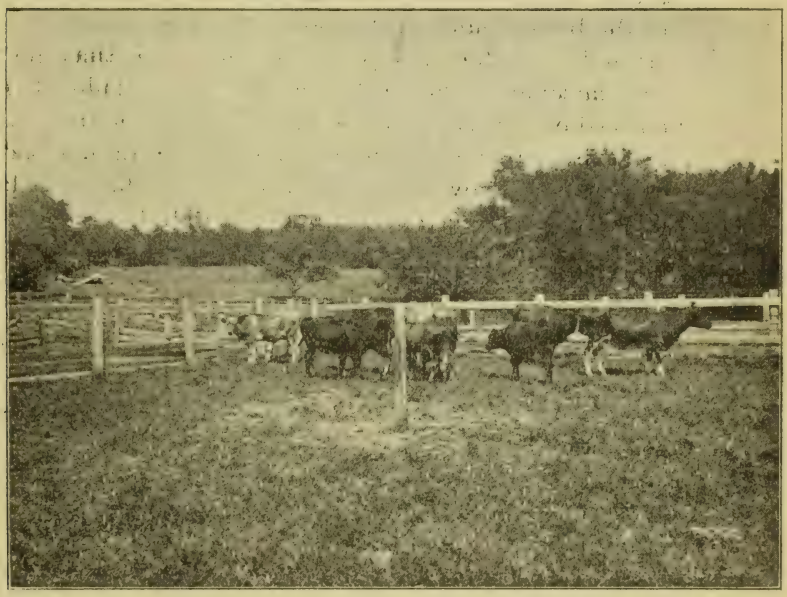
Cause and Nature of Disease.—Texas fever is an infectious blood disease of the ox tribe, and so far as is at present known the cattle tick (*Boophelus bovis*, Curtis) is the only natural means of infecting cattle with this disease. It is seen most frequently in cattle brought South from Northern uninfected points. The direct cause of this disease is the death and decomposition of the red blood cells together with an effort of the system to throw off these broken down cells. According to investigations made by the Bureau of Animal Industry,

we learn that this destruction of the red blood cells is brought about by a microscopic animal germ that enters the cell and breaks down its structure, so as to destroy its life and usefulness.

The Texas Fever Cattle Tick.—Every Southern stockman is familiar with the cattle tick. When the female ticks reach maturity, they have an oblong oval shaped body, and, when fully distended with blood, they are nearly half an inch in length and one quarter to five sixteenths of an inch wide. When mature they drop off on the ground and in a few days begin laying eggs, one female laying from 1,200 to 3,000. The length of time required for these eggs to hatch varies considerably with the temperature of the surrounding atmosphere. During the month of July we had eggs to hatch in the Laboratory in eighteen days after they were layed. Another lot of eggs, layed the last of April, required about seven weeks to hatch, and others, layed September 1st, have up to this time (November 15th) failed to hatch. When the young hatches it is an extremely small six-legged parasite, almost invisible to the naked eye. By occasionally placing moist blades of grass in the glass jar, covered with linen cloth, we succeeded in keeping the young ticks alive for about five weeks. Under natural conditions, as the ticks drop in the pasture or stable, one can easily see what a wide variation may exist in the time required for the tick eggs to hatch. During the winter by far the majority are killed by the cold, only those survive that are protected, as by a bed of straw, leaves, etc. For this reason, cattle brought South in winter, or early spring, have a better chance to live than those brought South later. During the spring the susceptible animals are sometimes attacked by so few ticks as to give them a light attack of Texas fever, and immune them to the disease before the "heavy tick crop" appears.

As soon as the young tick attaches itself to the skin of cattle, it begins to grow. In about a week it casts off its old skin (moults.) The parasite now has four instead of

three pairs of legs. In about a week from the first moult a second moult takes place, when the tick reaches the adult state. By the end of the third week the female tick has become impregnated, her body distended to its fullest extent with blood, and she is ready to drop off the cow and begin laying eggs. In warm weather when the conditions



Picture of ten (10) of the twenty (20) Mississippi Experiment Station cattle used in the Texas fever experiment. Picture taken at the Missouri Experiment Station, Columbia, Mo.

are favorable it requires from two to three weeks, on an average, for these eggs to hatch. Hence, five or six weeks is the shortest time required for the tick to complete the entire cycle of life. If all the mature female ticks on a farm were collected early in the spring, when the first crop of ticks appears, and burned, and no others brought in, the farm would soon be rid of this parasite. Instead of handpicking, the ticks may be killed by applying, by

means of a brush, cotton seed oil to the skin of the animal infested with them.

The body of the female tick becomes distended with the blood of Southern cattle that contain numerous Texas fever germs, and in some way these germs are transmitted to the young tick. The oviduct of the tick is situated just posterior to its mouth. During egg laying, blood from the mouth is collected on the shell of the eggs, and the current theory is that the young tick gets the germ by eating the blood found on its shell.

It is during the early period of their lives that the ticks cause mischief. They often crawl upon blades of grass and bushes. A cow may be grazing along in the pasture or woods and these minute parasites get on her body as she passes. They attach themselves to the soft skin of the body, and insert their saw-like mandibles deep into the skin, thus coming in contact with the small blood vessels. In this way, a direct communication between the body of the cow and that of the tick is established. If the cow is not immune to the disease her blood becomes infected and Texas fever usually follows in from twelve to thirty-five days. Southern cattle when quite young are attacked by this parasite, and before they are grown are immune to Texas fever. Possibly the milk of the mother, that is immune, aids in immuning the calf. Possibly also the circulation of the immune mother's blood in the "foetus in utero" causes the calf to be partially immune at birth.

Quarantine Regulations.—The United States Department of Agriculture has established a rigid quarantine line, known as the "Texas Fever Line," separating the infected from the noninfected territory, or, in other words, that portion of the country where the cattle tick is found from the section in which the tick has never been found, or, if found at any time, has been exterminated. At present this quarantine line extends north of the greater portion of North Carolina, and embraces, as infected territory, the whole of South Carolina, Georgia, Florida, Alabama, Mississippi, and

Louisiana, and includes the greater portion of Texas, Indian Territory, and California as Texas fever districts. If cattle from north of this line be shipped south of the line, they will, as a rule, become infected with cattle ticks and frequently die of Texas fever, especially if brought South

Cattle ticks (the carriers of the "Acclimation" fever germ) on skin of scrotal region of steer No. 5 that died of "Acclimation" fever.

during warm weather. If cattle south of the line be shipped north of it they, while immune to Texas fever themselves, may carry the cattle tick on their bodies, drop them, and sow the seed of widespead infection among Northern susceptible cattle. Hence, the Department of Agriculture allows the shipment of cattle, from points south to those north of the Texas fever line only between the 15th of November and 15th of February, except for immediate slaughter. In the latter case, the cars in which these cattle have been transported, when they reach their destination, are thoroughly washed and disinfected before

using for other cattle, so as to be sure that all ticks and tick eggs, that may have been left in the car, are destroyed. Regulations of the Department of Agriculture prescribe that the cars used to transport such animals, and the pens in which they are fed and watered, and the pens set apart for their reception at points of destination, shall be disinfected in the following manner:

(*a*) Remove all litter and manure. This litter and manure may be disinfected by mixing it with lime or diluted sulphuric acid, or, if not disinfected, it may be stored where no cattle can come into contact with it until after December 1.

(*b*) Wash the cars and the feeding and watering troughs with water until clean.

(*c*) Saturate the walls and floors of the cars and fencing, troughs, and chutes of the pens with a solution made by dissolving four ounces of chloride of lime to each gallon of water. Or disinfect the cars with a jet of steam under a pressure of not less than fifty pounds to the square inch."

Dipping Cattle.—Dr. M. Francis, of the Texas Experiment Station, has, in connection with the Missouri Experiment Station, been conducting some experiments with dipping cattle in order to free them of ticks. The writer saw last June fourteen head of Texas steers that Dr. Francis had dipped the previous week and sent to the Missouri Station. Dead ticks, both large and small, were so numerous on some of these steers that the ticks appeared as a matted mass sometimes several inches in circumference. The basis of this dip was an oil, that kills the ticks by stopping up their breathing pores. The Department of Agriculture is conducting extensive experiments along this line, and we hope that these investigations will prove of such value that the quarantine regulations concerning Texas fever may be modified.

Symptoms of Texas Fever.—In spring and summer, the disease usually manifests itself in an acute form, when the symptoms are well marked. These vary with the severity of the attack, constitution of the animal, and its surroundings. Extremely warm weather is depressing to

Texas ("Acclimation") fever cattle ticks on skin of thigh taken from Nos. 11 and 7 that died of Texas fever.

the animal, lessens its constitutional vigor, and increases the likelyhood of infection from ticks.

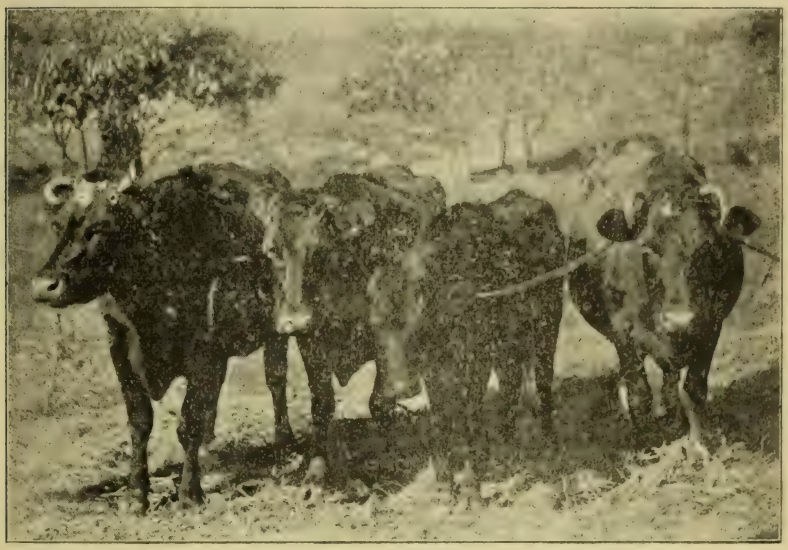
The first indication of the disease is a rise of temperature, which varies in the acute form of the disease from 104 to 105 deg. F. Soon after the rise in temperature is observed (occasionally at the same time) the animal looks depressed and refuses to eat and drink. Constipation is usually present, but diarrhea may set in before death. The red blood cells being broken up, the red coloring matter is disolved into the liquid part of the blood, and frequently filters through the kidneys and gives the urine a red or bloody color, hence the disease is sometimes spoken of as "red water" in cattle. The spleen, liver, and kidneys, in endeavoring to get rid of the dead blood cells, become inflamed; for this reason pain may be manifested over the loins (kidneys) and the flanks drawn up. The

loss of red blood cells (the oxygen carriers) and the high fever cause the breathing to become very rapid, from 70 to 120 per minute. The pulse is rapid and weak. The animal lies down and may be unable to rise. The posterior extremities are first paralyzed, and the animal sometimes rises on its forefeet (contrary to nature) and is unable to rise on the hind ones. When unable to rise, death usually ensues in a few hours.

The first symptoms of the disease are usually manifested in from two to five weeks after the animal is exposed to infection. In case of No. 1, in our experiments, the first rise of temperature was found on the fourteenth day of exposure, death occurring on the 21st day of exposure. In case of No. 7., the first rise of temperature occurred on the morning of the fifteenth day of exposure, when her temperature was 105o F. Her temperature remained up only during that day, and we have no other rise of temperature until August 28th, the fifty-second day of exposure, death occurring four days later.

Post-Mortem Appearances.—These vary somewhat, but on the whole are constant. We give below a portion of a letter that we received from Mr. Martin Seeger of Enterprise, Miss., when writing to us concerning the post-mortem appearances of cattle recently imported from Topeka, Kas., that were dying from some infectious disease. "The melt is almost twice the normal size and black. It was so soft that I could scrape it out without the least trouble, in fact, it was rotten. The gall bladder was larger than usual and its contents almost as thick as clabber and lumpy. The liver some larger than normal, and of a yellow cast, as it would look with an excess of gall. The bladder was filled to almost twice its normal size with bloody urine." Added to the above we might say that either or both kidneys may be inflamed and have small areas of blood scattered throughout its structure. On the outer and inner surfaces of the heart extravasations of blood, from the size of a pin point to that of

a man's thumb, are almost invariably found. The blood is very thin, watery (due to loss of red blood cells) and does not coagulate readily.



No. 15. No. 18. No. 16. No. 17.
Four "Unacclimated" Northern cattle kept on disinfected (tick free) pastures at the Mississippi Experiment Station.

The Outbreak at Enterprise.

The case referred to above in Mr. Seeger's letter proved to be but the beginning of a very virulent attack of Texas fever in a herd of cattle belonging to the Kapmer, Miller Cattle Co. of Enterprise, Miss. These cattle arrived at Enterprise from Kansas on the 23d of January, 1897, apparently in good health. On January 26th the cattle were given a pure pine straw bedding, the straw having been collected from under some trees in an old field to which numerous Southern cattle had, the previous summer and fall, had access. Cattle had also been known to remain under these trees at night, and, undoubtedly, numerous mature ticks dropped into this staw. Upon examination

of the bodies of diseased and dead animals, we found many, and in some cases countless numbers of, small ticks. The warmth of the animal body in contact with the pine straw bedding acted as an incubator for the thousands of tick eggs in the straw that had not already hatched. As soon as the young parasite hatched it readily attached itself to its host. The first cow that died was taken sick on February 6th, the twelfth day after coming in contact with the straw, and died on February 10th, the sixteenth day of exposure. We tried the serum treatment on this herd, and none of the animals so treated (except one cow almost past hopes of recovery when first treated) died, nor did any more new cases develop.

Preventive Treatment.—It was discovered by Dr. Behring of Berlin in 1890 that *if an animal had been made artificially immune to a certain infectious disease, its blood serum had the power of protecting other animals against that disease, as well as curing them when affected by such disease.* Diphtheria in children and tetanus (lock-jaw) in man and the horse are frequently treated with success by inoculation with blood serum of animals that have had these diseases. These two diseases, Diphtheria and Tetanus, are caused by vegetable microorganisms. The germs, by their growth and activity, elaborate a certain poisonous principle, *toxin*, that is in the main by its action on the animal system responsible for disease and death. Dr. Behring discovered that in the blood of animals that had recovered from tetanus there was a certain anti-poisonous principle that we call *anti-toxin.*

Dr. J. W. Connoway of the Missouri Experiment Station was the first to suggest that Texas fever might be prevented by blood serum inoculation. Our work at Enterprise, as well as some done by Dr. Connoway, was such as to give much encouragement as to the success of this treatment. But it has never been proven that in Texas fever the microorganism producing the disease (an *animal* germ in this case, while in Diphtheria and Tetanus a *vegetable* microorganism) causes a toxin. On the contrary, from the

result of our experimental inoculation of No. 20, we would be inclined to believe that there is no toxin produced by the Texas fever germ.

Experiments With Blood Serum as a Preventive and Cure for Texas Fever.

The results obtained with the serum treatment on the herd at Enterprise, Miss., and by Dr. Connoway of the Missouri Experiment Station were of such a promising character as to suggest the advisability of a more thorough investigation of its merits. To this end the Station purchased, near Columbia, Mo., a point considerably north of the Texas fever line, twenty (20) cattle (thirteen cows and seven two-year-olds). For the purpose of investigation the cattle were divided into five (5) lots. The serum used in these experiments was obtained from southern cows well covered with ticks. The blood was taken from the jugular vein and collected in sterilized glass jars, allowed to set about thirty-six hours on ice and the blood serum then drawn off into sterilized glass bottles and closed with sealing wax, after adding 4-10 per cent of carbolic acid. A small amount of serum was also prepared from a southern cow free from ticks, and it was this serum that was used for inoculating Nos. 3 and 7.

The quantity of serum given varied between wide ranges and tests were made to determine the efficiency of inoculation (*a*) before shipping cattle South, (*b*) inoculation before shipping and after reaching the South, (*c*) inoculation only after reaching the South, (*d*) inoculation with serum from cattle with ticks on them and serum from cattle without ticks, (*e*) inoculation with serum from cows sick with Texas fever, (*f*) inoculation with tick juice. One lot of the cattle was not inoculated but was kept free from ticks by enclosing on an uninfected lot and oiling their legs and soft skin.

Another lot was not inoculated but brought South and kept without treatment on infected pastures ("checks"). The cattle were all shipped from Missouri on the 6th of July, and reached the Mississippi Experiment Station on the evening of the 8th in apparent good condition.

Results.—The results of these experiments, the details of which are given below, indicate unmistakably that the blood serum inoculation as we practiced it had no effect either in preventing or curing Texas fever. Our experiments furnish us additional evidence, however, that the cattle tick is the agent for transmitting the disease, and that valuable breeding animals can be brought South at any time with little danger of contracting "acclimation" fever, provided they are kept free from ticks by placing in uninfected enclosures. Such animals should be regularly and carefully examined for ticks and the legs and soft skin of the body occasionally oiled.

Experiments in Detail.

Lot 1, 4 cattle.—This lot was treated with serum for ten days before leaving the North, and except No. 2, no further treatment was given them. They were turned on an infected pasture upon their arrival at the Station. The legs and soft skin of No. 4, were oiled to see if this would keep the ticks off, but it was so warm that it did not prove practicable to apply the oil often enough and in sufficient quantity to accomplish this end. All of this lot got ticks on them, had fever, and two of them died. Table 1 gives the time, temperatures, quantity of serum given, and observations made. From July 10th to 18th inclusive the temperatures of this lot were recorded twice daily and found normal. The temperature of Nos. 2 and 3 was taken twice a day from August 7th to September 13th inclusive, and they steadily improved. They were doing well November 15th.

TABLE NO. 1.

Lot 2, 4 cattle.—These cows were inoculated with serum before leaving Missouri and reinocculated on reaching Mississippi. No. 6, was in addition inoculated with 32 c.c. of bile from cow dying of Texas fever; No. 6, was also oiled, as No. 4, and with the same result. All of these cattle became infested with ticks, and all died of Texas fever. The temperatures of Nos. 6 and 7 were taken twice daily from August 11th, until their death. No. 6 gradually became worse and died September 19th. No. 7 had a rise of temperature August 28th, and died the afternoon of September 1st. On August 29th No. 6 was inoculated with 12 c.c., and on August 30th with 20 c.c. of bile from cow dying of Texas fever. On August 31st and September 1st No. 7 was inoculated with 104 c.c. of blood serum.

TABLE 1.

Date, 1897.	Hour.	No. 1. Grade Short Horn Cow, 9 yrs., 775 lbs.		No. 2. Grade Jersey Steer, 2 yrs., 465 lbs.		No. 3. Grade Jersey Heifer, 2 yrs., 500 lbs.		No. 4. Grade Hereford Cow, 8 yrs., 825 lbs.		Remarks.
		Temperature Degree F.	Amount Serum Inj. No. c. c.	Temperature Degree F.	Amount Serum Inj. No. c. c.	Temperature Degree F.	Amount Serum Inj. No. c. c.	Temperature Degree F.	Amount Serum Inj. No. c. c.	
June 26	5 p. m.	102.2	20	102.5	12	102.3	12	.....	.....	All eating.
27	5 p. m.	.....	24	102.4	12	104.8	12	.....	.....	No. 3 heated by exercise.
28	8 a. m.	101.1	.....	101.7	.....	101.8	.....	.....	.....	
28	5 p. m.	102.4	24	103.4	12	103.0	12	.....	.....	
29	8 a. m.	100.8	.....	101.6	.....	102.4	.....	.....	.....	
29	5 p. m.	102.0	32	103.2	12	103.0	20	104.4	20	No. 4 heated by driving.
30	8 a. m.	102.2	.....	102.0	.....	102.3	.....	100.9	.....	
30	7 p. m.	102.6	.....	103.0	.....	102.6	.....	102.6	20	
July 1	8 a. m.	100.9	.....	101.6	.....	101.6	.....	100.4	.....	
1	6 p. m.	103.0	30	103.0	20	102.4	20	102.5	30	
2	8 a. m.	101.6	.....	102.0	.....	101.9	.....	101.3	.....	
2	5 p. m.	102.9	32	102.7	20	102.6	20	102.0	32	
3	8 a. m.	100.9	.....	102.6	.....	102.4	.....	100.8	.....	
3	5 p. m.	102.2	35	103.0	.....	103.7	20	103.5	40	
4	8 a. m.	101.4	.....	102.8	20	101.9	.....	101.1	.....	
4	6 p. m.	103.3	.....	103.6	.....	104.8	.....	104.4	.....	No. 3 heated by exercise.
5	8 a. m.	100.6	.....	103.0	30	101.2	.....	100.5	.....	En-route from Columbia, Mo., (Mo. Ex. Station) to Mississippi Experimental Station from July 6 to 8. Rested 7 hours in East St. Louis Stock Yards July 7.
5	7 p. m.	102.2	40	102 8	.....	102.4	30	101.8	40	
6	8 a. m.	101.0	.....	101.2	.....	101.7	.....	101.2	40	
9	11 a. m.	104.2	.....	103.4	.....	103.2	.....	102.2	.....	
9	6 p. m.	103.0	.....	103.4	.....	103.4	.....	104.2	.....	No. 4 oiled legs and soft skin.
19	6 a. m.	101.0	.....	100.4	.....	101.0	.....	100.1	.....	No. 4 oiled as on 9th. No. 2, 50 ticks on flanks and escutcheon.
19	6 p. m.	102.6	.....	102.0	.....	101.6	.....	101.3	.....	No. 3 one tick on udder.
20	6 a. m.	101.6	.....	101.7	.....	100.6	.....	104.2	.....	No. 4 udder inflamed. No. 3, 10 ticks—udder and flanks.
20	6 p. m.	102.1	.....	102.3	.....	102.3	.....	105.7	.....	No. 4 udder inflamed, 2 ticks (dead).
20	9:30 pm	.....	.....	.....	.....	.....	.....	104.8	.....	

	21	7 a.m.	100.6		101 7		100.3		102.7		No. 1, 22 ticks—udder, escutcheon and flanks.
	21	9 a.m.							102.8		No. 4, 2 ticks. Bathed udder with warm water.
	21	5 p.m.	103.2		102.1		101.7		105.1		No. 4 drenched with one ounce Potassium nitrate.
	22	7 a.m.	100.9		100.9		100.2		103.4		No. 3 15 ticks—udder and escutcheon. No. 4, 2 dead ticks. Udder better
	22	6 p.m.	104.1		102.6		102.5		105.4		
	23	7 a.m.	101.8		100.6		100.7		101.8		No. 4 oiled as on 9th.
	23	11 a.m.							102.4		No. 3 urine clear.
	23	6 p.m.	104.1		105.5		104.5		103.4		
	23	10:30p.m.							103.6		
	24	7 a.m.	105.6		103.7		100.5		103.6		No. 2 ticks numerous. No. 3 urine clear.
	24	12 m.	106 4		103.0						No. 1, 60 ticks—escutcheon. No. 3 urine clear.
	24	6 p.m.	105.3		102 5		102.6		106.1		No. 4 drenched as on 21st.
	24	10 p.m.	105.4								No. 1 eye inflamed, chewing cud.
	25	6 a.m.	106.3		102.6		100.7		105.7		No. 2 urine clear. No. 4 chewing cud. Drenched as on 21st.
	25	12 m.	108.2		104.6				103.8		
	25	6 p.m.	107.0		105 3		104.4		105.4		No. 1 chewing cud. No. 4 chewing cud. Udder hard. No. 3 Urine clear.
	26	6 a.m.	105.8		106.2	20	100.8		106.4		No. 1 stupid.
	26	11 a.m.	106.1		104.8				107.2		
	26	6 p.m.	106.9		107.4	35	103.4		107.2		No. 1 hangs head.
	26	10:30p.m.	105.1								
	27	7 a.m.	106.2		106.9		101.0				No. 3 urine clear.
	27	11 a.m.	102.7		104.6	20			104.4		
	27	5 p.m.	107.6		106.9	20	104.2		106.0		
	27	10:30p.m.	104.0								
	28	6 a.m.			106.1	20	101.6		103.2		No. 3 many ticks. No. 1 examined blood.
	28	10:30a.m.	Died								No. 1 ticks numerons, urine clear.
	28	6 p.m.			107.2	40	102.6		105.7		No. 4 urine black. Drenched, 1 lb. salts and 30 grs. calomel.
	29	6 a.m.			106.1		101.9		104.2		
	29	12:30p.m.			97.0				104.3	40	No. 4 purgative acted.
	29	5 p.m.			107.3		102.7		103.7		Nos. 2 and 3 ticks numerous.
	29	6:30 p.m.							Died		No. 2 drowsy.
	30	7 a.m.			106.1	20	102.6				
	30	5 p.m.			106.9		102.9				No. 3 lively.
	31	6 a.m.			105.5		102.3				
	31	6 p.m.			105.0		103.3				
Aug.	1	7 a.m.			104.6		101.6				
	1	6 p.m.			106.0	15	104.4				No. 2 lying in sun. Urine clear—examined blood.
	2	6 a.m.			102.4		102.0				
	2	5 p.m.			104.3		104.9				No. 2 eating, 2 mature ticks. No. 3 several mature ticks.
	3	6 a.m.			103.0		101.8				No. 3 urine little dark.
	3	5 p.m.			106.0		104.3				
	4	7 a.m.			102.4		102.5				No. 2 numerous large ticks. No. 3 urine little dark.
	4	6 p.m.			104.0		103.5				
	5	6 a.m.			102.3		103.1				All experiment cattle inspected by Dr. Oliver of Columbus, Miss.
	5	6 p.m.			102.9		103.6				No. 3 urine clear.
	6	6 a.m.			101.7		102.9				No. 2 chewing cud. No. 3 lively.
	6	6 p.m.			103.1		102.4				No. 3 collected 37 mature ticks.

TABLE 2.

Date, 1897.	Hour.	No. 5. Grade Jersey steer, 2 years. 500 lbs. Temperature Degree F.	No. 5. Amount Serum Inj. No. c.c.	No. 6. Grade Aberdeen Angus Heifer, 2½ years. 500 lbs. Temperature Degree F.	No. 6. Amount Serum Inj. No. c.c.	No. 7. Grade Short Horn Cow, 11yrs., 1,030 lbs. Temperature Degree F.	No. 7. Amount Serum Inj. No. c.c.	No. 8. Jersey Cow, 6 years. 800 lbs. Temperature Degree F.	No. 8. Amount Serum Inj. No. c.c.	Remarks.
June 26	5:30 p. m.	102.4	12	104.0	12	102.2	24	....	....	
27	5 p. m.	102.5	12	102.6	12	101.8	24	.....	.....	
28	8 a. m.	102.0	.....	101.6	.....	101.6	.....	.....	.....	
28	5 p. m.	102.6	12	102.8	12	102.1	24	.....	.....	
29	8 a. m.	101.4	.....	102.0	.....	101.4	.....	.....	.....	
29	5 p. m.	102.9	20	103.3	20	103.0	32	102.0	20	
30	8 a. m.	103.2	.....	101.9	.....	101.5	.....	101.2	.....	
30	7 p. m.	102.7	.....	103.8	.....	102.0	.....	102.1	20	
July 1	8 a. m.	102.0	.....	101.3	.....	100.9	.....	101.3	.....	
1	7 p. m.	103.0	20	102.2	20	102.7	30	101.9	30	
2	8 a. m.	102.0	.....	101.9	.....	103.6	.....	101.6	.....	
2	5 p. m.	101.9	20	102.6	20	103.6	30	102.0	32	
3	8 a. m.	101.6	.....	101.9	.....	100.6	.....	101.3	.....	
3	5 p. m.	102.7	20	103.6	20	102.3	40	102.0	40	
4	8 a. m.	101.4	.....	102.0	.....	101.3	.....	101.3	.....	
4	6 p. m.	103.5	.....	104.8	.....	102.9	.....	102.6	.....	
5	8 a. m.	101.6	.....	101.9	.....	101.2	.....	101.2	.....	
5	7 p. m.	102.8	30	102.8	30	101.6	40	101.4	40	
6	8 a. m.	101.3	.....	101.8	.....	101.2	20	101.2	40	
9	11 a. m.	103.6	12	103.6	12	102.4	20	103.8	20	
9	6 p. m.	103.4	.....	103.6	.....	103.6	.....	106.0	.....	No. 6 oiled soft skin of body. No. 8 in heat.
10	6 a. m.	101.2	.....	101.6	.....	100.6	.....	.....	.....	
10	6 p. m.	102.4	12	102.8	12	101.8	20	101.0	20	
11	6 a. m.	101.3	.....	101.8	.....	100.8	.....	101.1	.....	
11	5 p. m.	103.5	12	104.4	12	102.4	20	102.7	20	No. 6 oiled as on 9th.
12	6 a. m.	101.6	.....	102.2	.....	101.5	.....	101.1	.....	

12	6 p.m.	102.7	12	101.9	12	101.4	20	102.4	20	
13	6 a.m.	100.8	.....	101.6	.....	100.4	.....	100.4	.....	
13	6 p.m.	102.7	.....	101.9	.....	100.6	.....	102.1	.....	
14	6 a.m.	100.8	.....	101.8	.....	100.1	.....	99.9	.....	
14	6 p.m.	103.3	12	103.8	12	102.2	20	102.2	20	
15	6 a.m.	101.2	....	102.4	.....	101.0	.....	100.6	.....	
15	6 p.m.	103.3	.....	103.8	.....	102.8	.....	103.2	.....	
16	6 a.m.	101.6	.....	102.0	.....	100.7	.....	100.6	.....	
16	6 p.m.	103.8	.....	103.7	12	101.7	.....	103.4	20	
17	7 a.m.	100.2	.....	100.7	.....	101.0	.....	101.0	.....	
17	6 p.m.	101.7	20	101.7	.....	101.5	2	101.7	.....	
18	7 a.m.	101.0	.....	100.7	.....	101.4	.....	101.3	.....	
18	6 p.m.	102.9	15	103.2	12	101.8	20	102.1	20	No. 6 oiled as on 9th.
19	6 a.m.	100.3	.....	100.3	.....	100.7	.....	100.9	.....	
19	6 p.m.	102.2	20	103.0	12	102.0	.....	102.1	30	No. 5, 53 ticks on escutcheon.
20	6 a.m.	100.8	.....	100.7	.....	.....	.....	101.3	.....	No. 5 ticks on dewlap.
20	6 p.m.	102.1	20	102.6	15	102.0	20	102.1	20	No. 8, 35 ticks found
21	7 a.m.	101.7	.....	101.6	.....	100.5	.....	100.8	.....	No. 8, 45 ticks on udder, flank and elbow.
21	6 p m.	101.8	.....	101.8	.....	101.8	.....	101.5	.....	No. 6, 7 ticks on udder
22	7 a.m.	100.7	.....	100.5	.....	100.6	.....	101.5	.....	No. 5, 68 ticks: No. 6, 13 ticks on escutcheon; oiled soft skin; No. 7, 4
22	6 p.m.	104.4	.....	103.2	15	102.9	20	102.6	20	No. 8 numerous ticks. [ticks found.
23	7 a.m.	103.0	.....	103.3	.....	105.0	.....	104.1	.....	No. 6 oiled as on 22d. No. 8 pulse 69, respiration 56.
23	11 a.m.	103.0	.....	105.0	.....	.....	.....	.....	.....	
23	7 p.m.	104.1	20	103.9	.....	103.5	.....	106.9	.....	No. 8 urine clear; ticks numerous. No. 6 pulse 62; resperation 78.
23	10 p.m.	105.0	.....	.....	.....	.....	.....	.....	.....	No. 6 urine clear [No. 7 urine clear.
24	6 a.m.	100.8	.....	102.2	.....	100.1	.....	103.6	20	No. 7, 18 ticks.
24	12 m.	104.0	.....	104.5	.....	.....	.....	106.5	.....	
24	6 p.m.	104.3	20	104.0	20	102.1	20	106 8	20	No. 6 urine clear.
25	7 a.m.	105.5	15	.....	.....	99.9	.....	106.0	.....	No. 5 urine little dark. No. 7, 46 ticks.
25	12 m.	106 7	.....	102.9	.....	.....	.....	106.7	.....	
25	6 p.m.	105.7	.....	104.4	15	102.4	.....	106.3	15	No. 5 numerous ticks. Depressed. No. 6 urine little dark.
26	6 a.m.	105.5	15	104.4	15	100.7	.....	106.5	.....	No. 7 urine clear.
26	11 a.m.	105.2	....	104.2	.....	.....	.....	106.8	....	No. 5 many ticks; No. 8 pulse 108, respiration 114 and down in pas-
26	1 p.m.	.....	.....	.....	.....	.....	.....	103.0	20	ture, urine red.
26	5 p.m.	106.4	20	104.3	15	102.2	20	105.1	20	
26	11 p.m.	.....	.....	.....	.....	.....	.....	105.0	55	No. 8 pulse 84, respiration 112.
27	7 a.m.	107.4	.....	103.8	.....	100.6	.....	101.9	40	No. 6 urine clear. No. 5 many ticks on thighs and flank.
27	11 a.m.	107.0	20	102.2	.....	.....	.....	101.2	40	
27	3:30 p.m.	.....	.....	.....	.....	.....	.....	104.3	75	No. 5 urine red.
27	5 p.m.	107.6	35	104.4	20	101 8	.....	104.3	.....	
27	9:30 p.m.	.....	.....	.....	.....	.....	.....	Died	.....	
28	6 a.m.	106 5	20	101.6	.....	100.9	.....	.....	.....	No. 7 numerous ticks
28	6 p m	107 8	40	103.0	20	101.5	.....	.....	.....	
29	6 a.m.	107 1	.....	102.5	.....	101.0	.....	.....	.....	
29	5 p.m.	108.0	.....	103.3	.....	101.7	.....	.....	.....	[dram fld. ext. digitalis; 1 qt. sweet milk.
30	8 a.m.	103.6	20	102.6	20	100 8	.....	.....	.....	No. 7 many ticks. No. 5 drenched 1 ounce alcohol, quinine and 1

TABLE 2.—CONTINUED.

Date, 1897.	Hour.	No. 5. Grade Jersey Steer, 2 yrs.,500 lbs. Temperature Degree F.	No. 5. Amount Serum Inj. No. c. c.	No. 6. Grade Aberdeen Angus Heifer, 2½ years, 500 lbs. Temperature Degree F.	No. 6. Amount Serum Inj. No. c. c.	No. 7. Grade Short Horn Cow, 11yrs., 1,030 lbs. Temperature Degree F.	No. 7. Amount Serum Inj. No. c. c.	Remarks.
30	12 m.	.....	20	.....	.....	101.9	.....	No. 5 died during night.
30	5 p.m.	102.8	.....	103.7	.....	.....	.....	
31	6 a.m.	Died	.....	101.5	.....	101.7	.....	No. 6 drenched ¼ lb. salts. Refussd to eat. 5 ticks. Oiled soft skin.
31	6 p.m.	.....	.....	104.6	.....	101.7	.....	
Aug. 1	6 a.m.	.....	.....	101.7	.....	101.3	.....	No. 6 panting.
1	6 p.m.	.....	.....	105.1	.....	101.4	.....	No. 6 chewing cud.
2	6 a.m.	.....	.....	101 3	.....	101.7	.....	No. 6 eats.
2	6 p.m.	.....	.....	106.8	.....	102.6	.....	No. 6 urine little dark.
3	6 a.m.	.....	.....	102.0	.....	101.8	.....	
3	6 p.m.	.....	.....	106.4	.....	102.5	.....	
4	6 a.m.	.....	.....	102 6	.....	101.7	.....	No. 6, 1 tick. No. 7 mature ticks.
4	6 p.m.	.....	.....	105.1	.....	.....	.....	
5	7 a.m.	.....	.....	102.7	.....	102.0	.....	No. 6, 15 ticks.
5	6 p.m.	.....	.....	103.9	.....	102.0	.....	No. 7 chewing cud. No. 6 chewing cud; oiled.
6	6 a.m.	.....	.....	103.0	.....	101.5	.....	No. 7 urine clear.
6	6 p.m.	.....	.....	104.0	.....	102.1	.....	No. 6 chewing cud. No. 7 urine clear.
7	6 a.m.	.....	.....	101.4	.....	101.1	.....	No. 6, 3 mature ticks.
7	5 p.m.	.....	.....	103.0	.....	101.7	.....	No. 6 urine clear.
8	7 a.m.	.....	.....	102.4	.....	101.1	.....	No. 6 abscess at point of inoculation.
8	6 p m.	.....	.....	101.6	.....	102.0	.....	
9	7 a.m.	.....	.....	101.7	.....	100.8	.....	No. 6, 4 ticks. Urine clear.
9	6 p.m.	.....	.....	102.6	.....	101.7	.....	No. 6 oiled.
10	7 a.m.	.....	.....	102.0	.....	100.7	.....	
10	5 p.m.	.....	.....	102.7	.....	101.5	.....	

Lot 3, 3 cattle.—These were purchased in Missouri and brought South with the other cattle used in this experiment, but were inoculated in Mississippi only. Ticks got on all three of them, all had Texas fever, and all died.

TABLE 3.

Date, 1897.	Hour.	No. 9. Grade Aberdeen Angus Cow, 8½ years, 930 lbs.		No. 10. Grade Short Horn Cow, 10yrs., 1,025 lbs.		No. 11. Grade Jersey steer, 20 months, 385 lbs.		Remarks.
		Temperature Degree F.	Amount Serum Inj. No.c.c.	Temperature Degree F.	Amount Serum Inj. No.c.c.	Temperature Degree F.	Amount Serum Inj. No.c.c.	
July 9	10 a.m.	103.4	20	102.8	20	103.0	12	No. 9 oiled soft skin & legs.
9	7 p.m.	104.6	.....	104.1	.....	104.0	.....	
10	6 a.m.	100.4	.....	100.4	.....	101.4	.....	
10	6 p.m.	101.8	20	101.4	20	102.6	12	
11	6 a.m.	101.0	.....	100.6	.....	103.1	.....	
11	6 p.m.	103.6	20	102.6	20	104.5	12	
12	6 a.m.	102.1	.....	101.6	.....	102.3	.....	
12	6 p.m.	103.1	20	101.7	20	104.1	12	
13	6 a.m.	100.0	.....	99.9	.....	101.8	.....	
13	6 p.m.	100.2	.....	102.6	.....	102.0	.....	
14	6 a.m.	100.0	.....	100.4	.....	101.0	.....	
14	6 p.m.	103.9	20	101.4	20	104.1	12	
15	6 a.m.	100.8	.....	102.0	.....	102.0	.....	
15	6 p.m.	102.6	20	103.0	20	104.4	15	
16	6 a.m.	102.0	.....	100.6	.....	101.7	.....	
16	6 p.m.	104.0	.....	102.7	20	104.4	.....	
17	7 a.m.	99.1	.....	100.4	.....	100.6	.....	
17	6 p.m.	101.0	20	101.6	20	102.2	20	
18	6 a.m.	100.9	.....	100.4	.....	101.1	.....	
18	6 p.m.	101.6	20	101.5	.....	103.3	15	
19	6 a.m.	99.4	.....	100.5	.....	100.3	.....	
19	6 p.m.	102.2	30	102.0	30	102.5	30	
20	6 a.m.	100.2	.....	100.9	.....	100.9	.....	
20	6 p.m.	102.8	20	102.5	30	103.6	20	

TABLE 3.—CONTINUED.

Date, 1897.	Hour.	No. 9. Grade Aberdeen Angus Cow, 8½ years, 930 lbs.		No. 10. Grade Short Horn Cow, 10yrs., 1,025 lbs.		No. 11. Grade Jersey steer, 20 months, 385 lbs.		Remarks.
		Temperature Degree F.	Amount Serum Inj. No. c. c.	Temperature Degree F.	Amount Serum Inj. No. c. c.	Temperature Degree F.	Amount Serum Inj. No. c. c.	
July 21	7 a. m.	100.1	.....	100.2	.....	103.7	.....	No. 11 many ticks. [elbow.
21	6 p. m.	100.8	.....	100.6	.....	102.6	.....	No. 9, 11 ticks. [flanks and
22	6 a. m	100.3	.....	99.0	.....	102.4	20	No. 11 depressed, 24 ticks,
22	6 p. m.	103.0	.....	102.5	.....	106.2	20	No. 11 urine clear.
23	6 a. m.	101.1	.....	100.1	.....	103.8	.....	No, 9 oiled lg. and soft skin.
23	11 a. m.	.....	.....	.....	.....	103.9	.....	No. 11 resp. 98, pulse 58.
23	6 p. m.	104.9	20	104.6	20	106.5	32	No. 11 resp. 88, pulse 34. No.
23	11 p. m.	.....	.....	.....	.....	108.0	.....	10, 46 ticks. [Urine clear.
24	7 a. m.	100.5	.....	101.5	.....	106.4	20	No. 11 resp. 58, pulse 76.
24	12 m.	.....	.....	.....	.....	107.0	.....	
24	6 p. m.	103.3	20	106.2	20	105.5	.....	No. 11 resp. 76, pulse 72.
24	9:30 p. m.	.....	.....	.....	.....	106.4	40	Swel. on neck. [Ch. cud.
25	6 a. m.	100.0	.....	104.0	.....	106.2	.....	No. 11 resp. 66, pulse 74.
25	12 m.	.....	.....	.....	.....	106.4	.....	No. 10 urine cle'r. No. 11 eat'g
25	6 p. m.	104.1	15	104.2	12	106.0	20	No. 11 resp. 84, pulse 72.
26	6 a. m.	101.7	20	104.5	.....	106.4	35	No. 9 urine clear.
26	11 a. m.	.....	.....	.....	.....	105.7	.....	(better.
26	6 p. m.	103.0	20	106.6	35	107.0	20	No. 11 resp. 92, pulse 82. Looks
27	7 a. m.	100.5	.....	105.3	.....	105.6	.....	No. 11 eating.
27	11 a. m.	.....	.....	.....	40	106.4	35	No. 10 ticks on udder,
27	5 p. m.	103.2	20	106.2	40	106.7	35	thighs; urine dark.
28	6 a. m	100.3	.....	105.8	40	106 3	40	No. 10 ticks; escutcheon.
28	5 p. m.	101.7	20	104.6	35	105.8	40	No. 10 sluggish; neck bent
29	6 a. m.	100.4	.....	105.1	.....	100.0	.....	to right side.
29	12-30 p. m.	.....	.....	102.2	20	Died	.....	No. 10 down, could not get
29	5 p. m.	102.7	.....	102.3	20	.....	.....	up; bloody urine. Drench-
30	7 a. m.	100.1	20	101.3	20	.....	.....	ed 1 quart sweet milk.
30	2 p. m.	.....	.....	Died	.....	.....	.....	
30	5 p. m.	102.9	.....	No. 10 bloody urine; drenched as on 29th; No. 11				
31	6 a. m.	101.8	.....	same; also gave 1 oz. each of alcohol and quinine.				
31	6 p. m	104.3	.....	The temperature of No. 9 was taken twice daily				
Aug. 1	7 a. m.	100.8	.....	from Aug. 2d to 27th inclusive. She was taken				
1	5 p. m.	104.4	.....	sick Aug. 22d and died of Texas fever Aug. 27th.				

Lot IV, 3 cattle.—These cattle were brought South and kept on infected pastures without treatment. Ticks infested all of these, all had Texas fever, and one (1) died.

TABLE 4.

Date, 1897.	Hour.	No. 12. Grade Jersey Cow, 9 yrs., 925 lbs. Temperature, Deg. F.	No. 13. Grade Jersey Cow, 6 yrs., 710 lbs. Temperature, Deg. F.	No. 14. Grade Aber'n Angus Heifer, $2\frac{1}{2}$ yrs. 460 lbs. Temperature, Deg. F.	Remarks.
July 9	10 a.m.	102.0	102.8	103.1	
9	7 p.m.	104 6	104.5	104.2	
10	6 a.m.	100.8	100.6	100.8	
10	6 p.m.	101.0	102.8	101.8	
11	6 a.m.	100.8	101.6	100.8	
11	6 p.m.	102.1	102.6	103 2	
12	6 a.m.	103.0	101.8	101.8	
12	6 p.m.	102.6	101.8	102.4	
13	6 a.m.	102.0	101 2	100.0	
13	6 p.m.	102.2	101 7	100.2	
14	6 a.m.	102.0	100.3	100.2	
14	6 p.m.	102.2	103.0	103.6	
15	6 a.m.	101.2	101.3	101.8	
15	6 p.m.	102.2	103.0	103.0	
16	6 a.m.	101.3	101.8	101.0	
16	6 p.m.	102.5	102.8	103.6	
17	7 a.m.	100.2	101.7	100.6	
17	6 p.m.	101.3	102.0	101.7	
18	7 a.m.	102.2	101.4	101.0	
18	6 p.m.	101.2	101.8	103.6	
19	6 a.m.	100.7	101.1	100.2	
19	6 p.m.	105.7	102.4	102.1	No. 12 resp.80, pulse 78; udder inflamed.
20	6 a.m.	100.7	101.7	100.9	No. 14, 8 ticks; udder and dewlap.
20	6 p.m.	101.9	102.0	101.8	No. 14, 25 ticks.
21	6 a.m.	100.6	101.6	101.9	
21	6 p.m.	101.5	101.6	102.0	
22	7 a.m.	100.6	101.1	100.6	No. 13, 4 ticks; flanks and escutcheon.
22	6 p.m.	102.0	102 0	103 6	No. 12 inflamed udder.
23	7 a.m.	103.2	101.9	100.4	No.14 resp.91, pulse 72; 85 ticks.
23	6 p.m.	105.6	103.5	104 8	No.12 resp.92, pulse 88; 33 ticks.
24	7 a.m.	103.0	103.4	102.0	No.13, 2 ticks.
24	6 p.m.	105.6	105.5	104.7	No.14 ticks on dewlap, flanks and elbow
25	6 a.m.	101.5	104.4	102.4	No. 12 urine dark color.
25	6 p.m.	105.3	105.0	105.1	No. 13, 34 ticks.
26	6 a.m.	105.4	106.3	103.4	No. 12 urine dark colored.
26	6 p.m.	107.4	106.5	105.4	No. 12 depressed. No. 13 sluggish.
27	7 a.m.	106.0	106.4	105.8	No. 12 urine clear.
27	11 a.m.	106.0	106.8	.....	
27	5 p.m.	106.0	106.5	106.2	Nos. 13 and 14 ticks numerous.
28	6 a.m.	105.5	105.3	104.2	
28	5 p.m.	107.2	107.2	105.8	No. 12 urine dark.
29	6 a.m.	105.7	.....	105.0	
29	6 p.m.	106.9	105.8	106.0	No. 12 drowsy.
29	12:30a.m.	106.1	.....	.....	
30	7 a.m.	105.0	100.4	104.0	No. 13 urine bloody.
30	5 p.m.	106.2	103.2	105.6	No. 12 lying down.
31	6 a.m.	104.0	102.5	104.5	No. 12 lying down, could not get up.
31	4:30 p.m	Died	.....	.....	
31	6 p.m.	.....	103 3	105.3	No. 12 examined blood.
Aug. 1	6 a.m.	.....	101.9	104.0	
1	5 p.m.	.....	102.6	103.7	
2	6 a.m.	.....	100.9	101.3	No. 13 better.
2	6 p.m.	.....	103.2	105.6	No. 14 eating; 6 mature ticks.
3	6 a.m.	.....	101.3	103.8	No. 13 sluggish.
3	6 p.m.	.....	103.9	105 8	No. 14 urine dark colored.

TABLE 4.—CONTINUED.

Date, 1897.	Hour.	No. 13. Grade Jersey Cow, 8 years, 710 lbs. Temperature. Deg. F.	No. 14. Grade Aber'n Angus Heifer, 2½ yrs. 460 lbs. Temperature. Deg. F.	Remarks.
Aug. 4	6 a.m.	102.3	102.7	No. 14 mature ticks. No. 13 eats well.
4	5 p.m.	103.2	105.0	No. 13 drew 1 pint blood from jugular vein.
5	6 a.m.	102.5	104.8	No. 14 ex. blood. No. 13 urine clear.
5	6 p.m.	102.6	104.7	No. 14 resp. 96, pulse 88.
6	6 a.m.	101.5	104.2	No. 14 coat rough. Collected mature ticks.
6	6 p.m.	102.6	104.7	No. 13 lively and eating.
7	6 a.m.	101.4	103.9	
7	6 p.m.	102.0	104.1	
8	7 a.m.	101.3	102.5	
8	6 p.m.	101.5	102.2	No. 14 col. 20 mature ticks. No. 13 ticks num.
9	7 a.m.	101.3	100.6	
9	6 p.m.	102.7	101.0	
10	7 a.m.	101.3	100.6	
10	6 p.m.	102.0	102.1	
11	7 a.m.	101.0	100.5	
11	5 p.m.	101.4	104.0	
12	7 a.m.	101.0	101.5	
12	5 p.m.	102.0	104.4	
13	6 a.m.	100.9	104.3	
13	5 p.m.	102.1	100.2	
14	7 a.m.	100.5	100.9	
14	6 p.m.	102.6	104.1	
15	7 a.m.	101.0	102.4	
15	6 p.m.	101.8	103.8	
16	6 a.m.	100.5	102.0	
16	6 p.m.	102.3	103.6	
17	6 a.m.	100.6	101.4	
17	5 p.m.	102.2	103.6	
18	6 a.m.	100.9	101.3	
18	6 p.m.	101.7	103.8	
19	6 a.m.	102.0	104.1	
19	6 p.m.	102.6	104.4	
20	6 a.m.	101.4	103.3	
20	6 p.m.	102.4	103.9	
21	6 a.m.	101.6	.....	
21	6 a.m.	.....	104.0	
22	6 a.m.	101.2	101.2	
22	6 p.m.	102.5	104.3	
23	6 a.m.	100.6	99.7	
23	6 p.m.	102.0	103.9	
24	6 a.m.	101.2	100.9	
24	6 p.m.	102.4	103.7	
25	6 a.m.	104.6	99.7	
25	6 p.m.	102.4	104.6	
26	6 a.m.	100.6	100.5	The temperature of Nos. 13 and 14 were taken twice daily from August 28th to September 12th inclusive. They steadily improved and were well November 15th.
26	6 p.m.	102.4	104.0	
27	6 a.m.	101.1	101.4	
27	5 p.m.	.....	104.4	

Lot V, 6 cattle.—When these six tattle reached Starkville (about a mile from the Experiment Station) their hoofs and legs were oiled with cotton seed oil (applied with common paint brush) so as to prevent ticks crawling upon them while driving to the Station. On reaching the Station. they were placed in an uninfected pasture (one in which no cattle had been since the last killing frost) of about an acre. They were fed while keeping there, on cotton seed, cotton seed meal, wheat bran, and Johnson grass hay. During the month of August it was very dry, and some of them lost their appetite. These were grazed occasionally, for several hours a day on the College campus, but *always before grazing their hoof, feet, legs, lower jaw, and dewlap were oiled.*

On August 9th, No. 20 was for the first time inoculated with an infusion of tick juice and tick eggs. (The preparation, filtering, and inoculation of this infusion required about two hours, was done with antiseptic precautions, and tick juice and filtrate were kept at 37.5 deg. C.)

On August 18th, 25th, and 31st, No. 19 was reinoculated with infusion of tick juice prepared as that used on August 9th. A marked rise of temperature was observed the eighteenth hour after the first inoculation, and a fluctuation was observed even subsequent to the fourth inoculation. During this entire rise of temperature, however, the cow seemed very little depressed. Ticks used for the preparation of this juice were collected from both healthy and sick cows. This rise of temperature may have been due to the albumen in the tick juice. On September 14th No. 19 was turned on infected pastures after placing about eight or nine hundred young ticks on her. She died on October 4th of Texas fever.

On August 9th and 26th No. 20 was inoculated with blood serum taken from Nos. 13 and 9, and prepared in the usual way. No. 20 was turned on infected pastures the 14th of September, after placing about the same number of ticks on her as on No. 19. She died of Texas fever thirteen days afterward.

No. 15 is a grade Short Horn cow about nine years old and weighs 1,015 pounds.

No. 16 is a grade Short Horn cow about ten years old and weighs 915 pounds.

No. 17 is a grade Short Horn cow about eight years old. and weighs 1,000 pounds.

No. 18 is a grade Aberdeen Augus heifer about two years old and weighs 470 pounds.

The temperature of these four (4) cattle were taken twice daily from July 10th to September 18th inclusive (160 records of each) and they remained free of fever during the entire time. The temperatures of Nos. 19 and 20 were also taken twice a day from July 10th to August 8th (inclusive) and were found normal. Nos. 15, 16, 17, and 18, have had their pastures changed twice (but always after oiling), and we have never been able to find a tick on any of them.

TABLE 5.

Date, 1897.	Hour.	No. 19. Grade Short Horn Cow, 12 years, 895 lbs. Temperature, Deg. F.	No. 20. Grade Short Horn Cow, 14 years, 990 lbs. Temperature, Deg. F.	Remarks.
Aug. 9	6 a.m.	100.0	100.1	No. 19, injected 60 c.c. infusion of tick juice
9	1:30 p.m.	.....	.....	and tick eggs.
9	5 p.m.	102.3	102.3	No. 20, inj. 45 c.c. blood serum from No. 13.
10	6 a.m.	104.2	101.0	
10	10 a.m.	104.4	.....	
10	12 m.	104.1	.....	
10	5 p.m.	103.6	101.8	Oiled soft skin of both.
11	6 a.m.	102.0	100.1	
11	5 p.m.	103.0	101.9	No. 19, little stiff. Very sore. Walks with dif-
12	6 a.m.	103.2	100.3	No. 19 resp. 112; pulse 72. Eats well. ficulty.
12	9 a.m.	104.2	.....	
12	12:30p.m.	104.4	.....	
12	3:30p.m.	105.8	.....	
12	5 p.m.	105.2	101.4	
12	8 p.m.	104.4	.....	No. 19 eats well.
13	6 a.m.	102.0	101.3	
13	9 a.m.	102.3	.....	
13	6 p.m.	104.9	102.2	
14	6 a.m.	103.0	101.6	
14	12 m.	103.0	.....	
14	5 p.m.	103.3	106.6	
15	6 a.m.	101.1	105.0	
15	12 m.	.....	106.6	
15	5 p.m.	102.0	104.5	
16	6 a.m.	100.6	103.7	
16	9 a.m.	.....	104.7	No. 20 resp. 60; pulse 64.
16	12 m.	.....	103.1	
16	5 p.m.	101.8	103.2	No. 20 chewing cud.
17	7 a.m.	100.3	104.3	No. 20 prolapsed uterus, replaced.
17	9 a.m.	.....	107.0	No. 20 prolapsed uterus, replaced, sutured.
17	12 m.	.....	108.2	
17	5 p.m.	101.8	108.4	
18	7 a.m.	101.3	101.2	No. 19 inj. 78 c.c. warm infusion tick juice
18	5 p.m.	102.6	106.2	Nos. 19 and 20 oiled and grazed on campus.
19	7 a.m.	104.2	103.0	No. 19 eats well.
19	9 a.m.	105.2	.....	
19	10:30a.m.	106.1	.....	
19	12 m.	106.4	.....	
19	3 m.p.	105.0	.....	
19	5 p.m.	104.8	107.3	
20	7 a.m.	102.5	103.2	Oiled and grazed on campus.
20	9 a.m.	103.6	.....	
20	12 m.	105.4	.....	
20	3 p.m.	106.1	.....	
20	5 p.m.	105.5	105.3	
21	7 a.m.	102.4	103.0	Oiled and grazed on campus.
21	7 a.m.	102.8	.....	
21	12 m.	105.0	.....	
21	3:15p.m.	104.9	.....	
21	5 p.m.	105.4	106.8	
22	6 a.m.	102.1	101.3	
22	10 a.m.	104.2	.....	
22	12 m.	104.4	.....	
22	3 p.m.	104.2	.....	
22	6 p.m.	104.7	103.9	No. 19 very stiff in hind legs.

TABLE 5.—CONTINUED.

Date, 1897.	Hour.	No. 19. Grade Short Horn Cow, 12 years, 895 lbs. Temperature, Deg. F.	No. 20. Grade Short Horn Cow, 14 years, 990 lbs. Temperature, Deg. F.	Remarks.
Aug. 23	6 a.m.	101.2	100.3	No. 19 oiled legs and soft skin.
23	9 a.m.	101.9	.....	
23	12 m.	105.1	.....	
23	6 p.m.	104.0	104.0	
23	7 p.m.	104.4	.....	
24	6 a.m.	101.1	100.2	
24	9 a.m.	101.4	.....	
24	6 p.m.	102.9	102.4	
25	6 a.m.	99.6	99.6	No. 19 inj. 80 c.c. warm infusion tick juice.
25	12 m.	103.6	.....	
25	6 p.m.	105.9	105.2	Nos. 19 and 20 oiled and grazed on campus.
26	6 a.m.	101.1	100.1	No. 19, urine clear.
26	9:30a.m.	102.0	.....	No. 19 oiled and grazed on campus.
26	5 p.m.	102.9	105.8	No. 20, inj. 70 c.c. blood serum from No. 9.
27	7 a.m.	101.1	100.1	
27	12 m.	104.9	.....	
27	5 p.m.	103.2	102.6	
28	7 a.m.	101.6	103.2	No 20 little stiff.
28	11 a.m.	103.6	106.7	
28	5 p.m.	104.1	105.5	
29	7 a.m.	100.8	100.6	No. 20 swelling at point of inoculation.
29	5 p.m.	102.8	104.0	No. 20 small swelling on dewlap.
30	7 a.m.	100.1	101.1	No. 20 large swelling on dewlap; stiff.
30	12 m.	104.2	105.1	
30	5 p.m.	102.6	103.6	No. 20 very stiff; eats well.
31	8 a.m.	100.4	100.8	
31	5 p.m.	102.0	104.0	No. 19, inj. 80 c.c. warm infusion of tick juice
Sept. 1	7 a.m.	102.3	101.2	
1	12 m.	104.8	105.3	No. 19 small swelling at pint injection.
1	6 p.m.	104.0	102.6	
2	7 a.m.	102.3	101.5	No. 20 very stiff.
2	5 p.m.	102.7	102.5	
3	7 a.m.	102.4	102.7	
3	6 p.m.	104.1	103.7	
4	6 a.m.	101.0	101.4	
4	5 p.m.	102.7	102.3	

The temperatures of Nos. 19 and 20 were taken twice a day until Aug. 19, and improved.

On Sept, 14, these two cows were turned out with lots Nos. 1, 2, 3, and 4, after placing about 800 ticks on each of them.

No. 20 died Sept. 27, and No. 19 Oct. 4, of Texas Fever.

RECAPITULATION.

	Number of Cow.	When Taken Sick.	Temperature. Degree Fahrenheit.	Date of Maximum Temperature.	Temperature. Degree Fahrenheit.	Date of Minimum Temperature.	Temperature. Degree Fahrenheit.	No. Days Exposed Before Sick.	No. Days Sick Before Death.	No. Days Exposed Before Death.	Weight of Animals in pounds.	Age of Animals—Years.	Amount Serum Injected. No. c. c. (30 c.c.=1 ounce.)	When Died.
1	Imp. Indian cow.	July 22	104.1	July 25	108.2	July 5	100.6	14	7	21	775	9	237	July 28
2	Imp. Indian cow.	23	105.5	26	107.4	29	97.0	15	.....	.....	465	2	328	Nov. live.
3	Imp. Indian cow.	23	104.5	Aug. 2	104.9	10	100.6	15	.....	.....	500	2	146	Nov. live.
4	Miss. cow.	20	104.2	July 26	107.2	13	99.8	12	10	22	825	8	262	July 29
5	Miss. cow.	23	104.4	29	108.0	17	100.2	14	10	24	500	2	526	31
6	Ch'ks.	23	103.3	Aug. 2	106.8	Aug. 17	99.9	15	59	74	500	2½	*397	Sept. 19
7	Ch'ks.	23	105.0	31	106.9	July 25	99.9	15	41	56	1,030	11	588	1
8	Ch'ks.	23	104.1	July 24	106.8	14	99.9	15	5	20	800	6	737	July 27
9	Ch'ks.	23	104.9	Aug. 26	107.6	17	99.1	15	36	51	930	8½	345	Aug. 27
10	Ch'ks.	23	104.6	July 26	106.6	22	99.0	15	8	23	1,025	10	522	July 30
11	Ch'ks.	22	106.2	23	108.0	29	100.0	14	9	23	385	1½	507	30
12	Ch'ks.	23	105.6	26	107.4	17	100.2	15	9	24	925	9	None	31
13	Ch'ks.	24	105.5	28	107.2	14	100.3	17	.....	.....	710	6	None	Nov. live.
14	Ch'ks.	23	104.8	27	106.2	13	100.0	16	.....	.....	460	2	None	Nov. live
15											1,015	8½	None	
16											915	9	None	ALL LIVE FEB. 11, '98
17											1,000	8	None	
18											470	2	None	
19											895	12	None	Oct. 4
20											990	14	None	Sept. 27

Temperature of these 6 remained normal as long as kept on disinfected pastures.

Oiled and changed pastures October 23d, and November 23d.
" " " " " " "
" " " " " " "

These two cows were turned on infected pastures September 14, after placing on each about 800 young ticks.

All pronounced Sound on the afternoon of July 8, 1896. Missouri Experiment Station.

*No. 6 also inoculated with 32 c.c. bile from cow with Texas Fever. Nos. 15, 16, 17, and 18 have up to this date (FEBRUARY 11, '98) never been sick.

Postmortem Notes.

No. 1.—Cow died July 28th, 10:30 a. m. Antopsy held at once. Died lying on left side. *External appearance*, normal. Many ticks on thigh, udder, and flanks. *Internal appearance—Peritonaeum*, *Pleura*, *Lungs*, *and Pericardium*, normal. *Heart.*—Extravasations of blood on the outer surface of both ventricles and on a portion of endocardium. *Omentum.*—Yellowish. *Liver.*—About two and half times its normal size, edges rounded, yellowish, structure easily broken down. *Bile Duct.*—Very much distended. *Gall Bladder.*—Filled with gall that was thick and flaky. *Spleen.* About two and a half to three times its normal size, structure soft, friable. *First*, *Second*, and *Fourth Stomach.*—Normal. *Third Stomach.*—Contents abnormally dry. *Small Intestine.*—Surface congested. *Large Intestine.* — Normal. *Inguinal Lymphatic Glands.*—Congested. *Urinary Bladder.*—Very much distended with dark bloody urine. *Right Kidney.*—Inflamed, extravasations of blood on its outer surface. *Left Kidney.*—Congested. *Blood* throughout entire body thin and coagulates poorly.

No. 4.—Died 6:30 p. m., July 29th. Postmortem held an hour later. *External appearance.*—About thirty ticks found on belly and base of neck (points that had escaped oiling). Blood extravasations at points of inoculation. *Internal appearance.*—Veins of the body very much distended with blood. *Fat* of body yellowish. *Liver*, *Spleen*, *Bile Duct*, *Gall Bladder*, *Lungs* and *Stomachs*, as in No. 1. *Right Kidney.*—One and a half times its normal size, surface congested as that of No. 1. *Left Kidney.*—One half its normal size, extravasations of blood as in right. *Heart*—Extravasations of blood on outer surface of left ventricle, also, right ventricle similarly affected in part. Endocardium, petechiae at base of papillary muscles. *Pasterior Mediastinal Lymphatics*,—Congested.

No. 5.—Died July 31st, 7 a. m. Postmortem held 10:30 a. m. same day. *External appearance.*—Many ticks on flanks, thighs, scrotum, and neck. *Internal appearance—Fat*, as in No. 1, blood extravasations on same. *Peritonaeum*—Petechiae on greater portion of its surface. *Liver.*—Weight 13½ pounds, edges rounded, blood extravasations throughout its entire surface. *Spleen*, 3½ pounds, substance black and friable. *Bladder*, as in No. 1. *Kidneys* inflamed. *Lumbar Lymphatics*, very much inflamed, bloody. *Small Intestine*, as in No. 1. *Second Stomach*—Blood extravasations on its lower edge, other stomachs normal. *Heart*, as in No. 1.

No. 6.—Died 12 m. September 19th; examined 3 p. m. same day. *Flesh.*—Yellowish cast. *Fat*, *Liver*, *Spleen*, *Gall*, *Bladder* and *Heart*, as in No. 1. Ticks on flanks, neck, thighs, and udder.

No. 7.—Died about 4 p. m. September 1st; postmortem held 6 p. m. same day. *Liver*, *Spleen*, *Heart*, and *Kidneys*, as in No. 1. *Urine.*—Clear. Numerous ticks on body.

No. 8.—Died 9:30 p. m. July 27th; examined 10:30 a. m. July 28th. *Fat*, *Liver*, *Gall*, *Bladder*, *Spleen*, *Kidneys*, *Inguinal Lymphatics*, *Small Intestine*, and *Heart*, as in No. 1. *Brain.*—Extravasations of blood on surface of cerebellum and inner covering of brain. *Blood* of body very thin. Numerous ticks.

No. 9.—Died August 27th 3 p. m.; postmortem held 4:30 p. m. same day. *Liver*, *Spleen*, *Urinary Bladder*, *Gall Bladder*, and *Heart*, same as No. 1. Many ticks on body.

No. 10.—Died 2 p. m. July 30th; postmortem held two hours later. *Liver*, *Gall Bladder*, and *Gall.*—Weight 23½ pounds. *Spleen*—Weight 4 1-8 pounds. *Substance* of *Liver*, *Spleen*, *Heart*, *Urinary Bladder*, *Third Stomach*, *Omentum*, and *Small Intestine* same as No. 1. *Kidneys—Right*, very much inflamed, large clot of blood in pelvis, also 6 or 8 large calculi and numerous small ones. *Left Kidney*, inflamed, one large calculus and many small ones in pelvis. Numerous small ticks on body.

No. 11.—Died 12:30 p. m. July 30th, examined 2 p. m.

same day. *Liver*, weight 11 pounds. *Spleen*, weight 4½ pounds; substance of spleen and liver same as in No. 1. *First Stomach* contained a large amount of sand mixed with food. *Third Stomach*, *Urinary Bladder* and *Kidneys* as No. 1. Many ticks on soft skin.

No. 12.—Died 4:30 p. m. July 31st, postmortem held two hours later. *Liver*, weight 20¾ pounds. *Spleen*, weight 6¾ pounds. Substance of liver and spleen same as in No. 1. *Gall Bladder*, *Urinary Bladder*, *Small Intestine*, *Omentum* and *Heart*, same as in No. 1. *Stomach*, normal. *Brain*, structure normal, inner covering congested. Many ticks on body.

No. 19.—Died about dark October 4th. Symptoms unmistakably those of Texas fever. No postmortem held.

No. 20.—Down in pasture 5 p. m. September 26th, unable to rise. Complete paralysis at 10:30 a. m. September 27th, killed to relieve pain. Fat of body very yellow. *Liver*, very yellow. *Spleen*, black, structure of both organs same as in No. 1. *Heart*, extravasations of blood on outer surface of both ventricles, also a few spots on endacardium. *Urine*, bloody. *Ticks*, numerous.

ACKNOWLEDGMENTS.

We wish to extend our sincere thanks and appreciation to Dr. J. W. Connoway, of Missouri Experiment Station, for the great assistance he gave us in securing our experiment cattle, and planning for and starting our work in Missouri; to the Missouri Experiment Station that so kindly sheltered us and our cattle while at work in Missouri; to Col. J. R. Rippy, Secretary of Missouri State Board of Agriculture, for his faithful efforts to secure free transportation for our cattle from Columbia south; and to the M. and O. Railroad for the reduced rate given us on our car load of cattle from East St. Louis to Starkville, Miss., and the free transportation given us.

We also received valuable assistance from W. B. Clayton, M. S., and A. H. Barr, B. S., in conducting these experiments.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

Special Bulletin No. 43.

"Natural Plant Food;" Claims Made for It and Its Value.

Agricultural College, Miss., Feb. 15, 1898.

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Note.—The analysis and inspection of commercial fertilizers is by law done by the Professor of Chemistry in the College, who is the State Chemist. The results being considered of agricultural value are sent out by the Experiment Station. All communications in regard to these Bulletines or analyses should be addressed to State Chemist.

Mississippi Fertilizer Control.

UNDER THE AUSPICES OF THE
CHEMICAL DEPARTMENT OF THE
MISSISSIPPI AGRICULTURAL AND MECHANICAL COLLEGE.

"NATURAL PLANT FOOD;"

Claims Made for It, and Its Value.

By B. W. KILGORE, State Chemist.

SUMMARY:

A fertilizer material under the name of "Natural Plant Food" was sold in the State last season. It was claimed to be the "Best Fertilizer on Earth," and as a germinator of seed it was declared to have no equal. Great stress was laid on the statement that it was a natural product, and because of this was better than any fertilizer that could be made by man.

All the plant food in this material was claimed to be available, whereas analyses in the Laboratory showed it to contain very little available phosphoric acid, 34.2 pounds in a ton of 2,000 pounds, worth at present prices about $1.50. The phosphoric acid is the only fertilizer constituent of agricultural value in this material.

In experiments by farmers "Natural Plant Food" gave no apparent increase of crops. Laboratory analyses and field experiments agree in showing this material to have little or no agricultural value.

"Nacural Plant Food" is a low grade natural phosphate of too poor a quality to be used in the manufacture of acid phosphates or other fertilizers.

It was sold to farmers for from $11 to $17 per ton, whereas it has practically no agricultural value and could be bought at the mines for $2 to $3 per ton. The money spent for it was thrown away.

Farmers should apply to this department for information about fertilizers of questionable value before purchasing them.

INTRODUCTION.

During the past season (1897) several car loads of fertilizing material were sold in the State at different points by the American Fertilizer Company of Washington, D. C., under the name of "Natural Plant Food." This company made very extravagant claims for its fertilizer. The statements regarding the analysis and value of the material are ingenious and misleading, in fact, their method of advertising and sale had so many of the ear marks common to the well-known patent medicine methods that no surprise was caused when later in the season it was learned that the people selling the "Cheapest and Best Fertilizers on Earth," as they were pleased to call them, had also a monopoly of the "Best and Cheapest Family Medicine on Earth."

"THE CHEAPEST AND BEST FERTILIZERS ON EARTH."

The following is a fair illustration of the method of advertising and the claims made for the fertilizers:

"Every intelligent farmer knows that fertilizer is the best which can soonest start the seed to growing and cause the largest number of seeds to sprout and grow, out of the whole number planted. This, the Natural Plant Food has done in every case. The Natural Plant Food makes more seed grow, out of the whole number planted, than any other fertilizer on earth. It makes the seed come up much earlier and faster, grow more vigorously, withstand a drouth much longer and finally produce a much better crop than any other fertilizer yet known, as has been fully demonstrated and proven beyond all manner of doubt by tens of thousands of witnesses, to its marvelous germinating and forcing powers. This all goes to show that a natural fertilizer is of vastly more benefit to the soil

than an artificial imitation; for, after all, a chemical or artificial fertilizer is simply an attempt in an artificial manner, to supply the crops with a chemical mixture which is simply an imitation of a first-class natural fertilizer; surely the Almighty is a better chemist than the human race has yet produced and better knows the need of all growing things."

How high sounding and beautiful all this is—on paper! It is calculated to carry one beyond his element in admiration of nature and natural products because they are natural and not imitations.

Like unto the above, on a letterhead, with address, agencies, and other marks so similar that no one would mistake the source being the same as that from which the fertilizer literature came, is the advertisement of the

"BEST AND CHEAPEST FAMILY MEDICINE ON EARTH."

The following is an extract from the postscript of a circular letter sent to an agent, who sold "Natural Plant Food:"

"Although our medicines are the *best on earth*, they cost our customers less than one-half the usual price of other medicines, and are in such great demand that our agents realize for their service two or three times as much money as they could make in handling any other line of goods.

"Ours is truly the greatest discovery ever made in the medical line. We are the sole proprietors of these medicines and the exclusive agency for them should soon enable you with our help, to control the medicine trade in your teritory."

It seems unfair, from a material point of view, that one company should be the possessor not only of the best remedy for the ails to which human flesh is heir, but also of the "Best Fertilizer on Earth," for the germination of seed and the growth of plants.

CHARACTER OF BUSINESS DONE BY THE COMPANY SELLING "NATURAL PLANT FOOD."

Notwithstanding the confident claims made by the American Fertilizer Company for its "Natural Plant Food," it seemed disposed not to want it put on sale in the State on the same basis as other fertilizers sold, but manifested a disposition to evade the fertilizer law and to prevent the inspection, analysis, and tagging of their goods.

MISLEADING ANALYSIS OF "NATURAL PLANT FOOD."

Three grades of "Natural Plant Food" are sold by the American Fertilizer Company, Nos. 1, 2, and 3. The analyses of Nos. 1 and 2 as published by the Company are given below:

	No. 1 Per Cent.	No. 2 Per Cent.
Moisture (H2O)	1.78	1.78
Total Phosphoric Acid (P2O5)	18.00	21.60
Eq. to Bone Phosphate of Lime (PO2CA3)	39.24	47.15
Oxide of Lime (CaO)	29.16	29.16
Oxide of Sodium (Na2O)	1.32	1.32
Carbonic Anhydrite (CO2)	.....	.40
Silicic Anhydrite (SiO2) Sol. in Chloridic Acid	.....	9.77
Silicic Anhydrite (SiO2), Insol	.....	9.11
Oxide of Magnesia (MgO)	.....	4.62
Aluminic (AL2O3) and Ferric (Fe2O3) Oxides	.....	5.14
Total Potash Insoluble (K2O)	.....	1.00
Undetermined Residue	49.74	16.10
Total	100.00	100.00

"ALL PLANT FOOD AVAILABLE TO PLANTS IN THE SOIL."

The above analyses are misleading:

1st. In that they imply that materials like silica, mag-

nesia, carbonic acid, etc., have commercial values in fertilizers, whereas all our soils contain sufficient quantities for the use of plants, and they do not have values assigned to them as do *nitrogen, phosphoric acid, and potash.* These latter constituents are the only ones to which values are assigned in fertilizers, and it would appear that the other materials are added to cause the farmer to believe that they have money values too.

2d. The total phosphoric acid is stated to be qual to so much *bone phosphate of lime.* This statement implies that the phosphoric acid in "Natural Plant Food" is of equal value in agriculture to that contained in bones, whereas it is well known that the phosphoric acid in phosphate rock, as this is, is not of equal agricultural value to that in bones.

3d. The statement that is under the guaranteed analyses "All Plant Food Available to Plants in the Soil" is entirely misleading and a misrepresentation, since experiments with this fertilizer and analyses in this laboratory show that the plant *food in it is not available.*

ANALYSES OF NATURAL PLANT FOOD.

Five samples of "Natural Plant Food No. 1" have been analyzed in this laboratory with the results shown in the table:

Sample Number and Source.	Pounds Phosphoric Acid in 100 of Natural Plant Food.			Sand and Insol. matter in 100 lbs., N. P. F.
	Available.	Insoluble.	Total.	
No. 1, E. D. Gilmore, Amory, Miss.	1.82	16.36	18.18	24.38
No. 2, E. H. Reed, Reform, Miss.	1.20	20.16	21.36	25.27
No. 3. S. M. Tracy.	2.11	22.27	24.38	.....
No. 4, J. D. Hopper, Tiplarsville, Miss.	.....	.....	18.26	.....
*No. 5, American Fertilizer Co., Washington, D. C.	.....	.....	22.24	.....
Average.	*1.71*	*19.60*	*20.88*	*24.82*

*This sample was sent from Fernandina, Fla.

From these analyses it is seen that the samples contained an average of only 1.71 per cent of available phosphoric acid, or *34.2 pounds in a ton*, which at 4½ cents per pound—the present value given to available phosphoric acid in fertilizers—would make "Natural Plant Food No. 1" worth $1.54 per ton.

FARMER'S OPINIONS OF "NATURAL PLANT FOOD."

Several farmers who used "Natural Plant Food" last year were so disappointed in the yields of their crops that they wrote to this department in regard to it. A representative of this department visited a number of places where the material was sold and from the testimonials thus collected and those obtained by letter, the following opinions are condensed as to the effect of "Natural Plant Food" in the growth of crops.

OPINIONS.

Mr. E. H. Reed, Reform, Choctaw County:

Used 1,400 pounds on cotton and corn, at the rate of 150 to 200 pounds per acre. Used no other fertilizer, but left plots without fertilizer and could tell no difference between the unfertilized and that fertilized with "Natural Plant Food."

Mr. Sam G. Kelly, Reform:

Used 2,600 pounds on cotton and corn on bottom and hill land; left rows blank in bottom and could tell no difference. On hill it was used with stable and chip manure without any result from "Natural Plant Food." The other manure showed increase.

Mr. H. T. Brock, Reform:

Used 800 pounds on cotton and corn.

On cotton used about 200 pounds to acre on poor upland and could see no improvement.

Corn.—Used 300 pounds to acre on poor upland between

a plot manured with rakings from the lot at the rate of a half shovel to the hill and one manured with cotton seed at the rate of about fifteen bushels to the acre. The lot manure produced twice as good corn as the "Natural Plant Food" plot on which the corn was hardly worth gathering. The cotton seed plot also did better than the Natural Plant Food; but it was planted later and was caught by drought.

Mr J. E. Norris, Reform:

Used 600 pounds Natural Plant Food on cotton, which gave no improvement, though with stable manure there was a good increase of crop.

Corn.—Left some vacant plots and could not tell the difference between those and the Natural Plant Food ones.

Mrs. Mary Outzs, Mathiston, Webster Couuty:

Used several hundred pounds on cotton, corn, and vegetables. Could see no improvement in any case. On cotton it was used in alternate rows in comparison with stable manure and the difference in favor of the stable manure was so perceptible that passers along the road remarked on it.

Mr. Luke Devore, Mathiston:

Cotton.—(Used three sacks.) Used between stable manure and nothing. Could easily tell the row at which the stable manure stopped, but could tell absolutely no difference between nothing and Natural Plant Food.

Corn.—Used as above with stable manure and nothing. The stable manure made real good corn with heavy ears, while nothing and the Natural Plant Food produced only scrubby stalks with inferior nubbins. On this same land in 1892 a very heavy crop was raised by using fertilizer made by East Mississippi Fertilizer Company.

Mr. James Beacham, Evergreen, Itawamba County:

Used 2,000 pounds mostly on corn at rate of 200 pounds per acre, drilled in furrow with corn while planting; left

vacant plot and used some other commercial fertilizer (Home Mixture); could tell no difference between nothing and "Natural Plant Food," while the other fertilizers gave very marked increase of crop. Soil was poor sandy upland on which 200 pounds of good commercial fertilizer will almost double crop any average year.

Natural Plant Food was also used on potatoes and turnips, and was unable to see any improvement.

Mr J. W. Mullin, Evergreen:

Used 8,000 pounds at a cost of $15 per ton when other good fertilizer would have cost $18. It was applied in drill before bedding at rate of 200 pounds per acre.

Corn.—Tested with cotton seed and nothing; could see no difference between Natural Plant Food and nothing, while cotton seed made big improvement.

Cotton.—Tested beside stable manure, which gave very much better results.

Vegetables.—Used on several kinds of vegetables and could see no improvement. The land is a sandy loam upland which usually responds most readily to a complete fertilizer.

Mr. J. R. Burgess, Nettleton, Lee County:

Used 3,000 pounds at the rate of 200 pounds per acre on cotton and corn; also used other complete commercial fertilizer; and could tell no difference between Natural Plant Food and nothing, while the other fertilizer increased the crop to about double.

The land was sandy upland and fertilizers were drilled in before bedding.

Mr. T. S. Mullin, Evergreen:

Used 600 pounds on ordinary sandy upland and could see no improvement in the crop.

Mr. J. F. Fears, Bristow, Monroe County:

Used 175 pounds at rate of 200 pounds per acre on yellow clay upland and could tell no difference from it and

nothing, while home made fertilizer gave good results. Complete fertilizers usually give good returns on this soil.

Mr. J. M. Kellum, Dido, Choctaw County:

Used 1,600 pounds on corn and cotton on upland and bottom at rate of 100, 150, and 200 pounds per acre applied before and after planting. Cotton seed, stable, and pen manure were used in comparison, and gave good results, though the Natural Plant Food did not seem to pay.

Mr. J. E. Bright, Amory, Monroe County:

Used 200 pounds at rate of 150 pounds per acre on clay land, applied in drill when bedding.

Left no vacant plot, but estimates that Natural Plant Food increased crop about one-third, but only about half as much as stable manure. Natural Plant Food cotton was considerably behind in weed and fruit, and did not give satisfaction.

Mr. J. E. Hopper, Tiparsville, Miss.:

Used 2,000 pounds on sandy loam soil. The fertilizer was applied in furrow and bedded on. The yield where "Natural Plant Food" was used was no better than where nothing was applied, while a complete fertilizer (Gossypium) about doubled the yield on the same land. Mr. Hopper states that a car load was used in his section without any returns.

From these *opinions* and from the analyses made in the laboratory it is seen that "Natural Plant Food" has very little if any agricultural value in immediately increasing the growth of crops.

WHAT IS "NATURAL PLANT FOOD."

"Natural Plant Food" No. 1, analyses of which are presented in this bulletin, is unquestionably a low grade natural phosphate, likely Florida soft phosphate. It is too poor a quality to be used in the manufacture of acid phosphate and other fertilizers, and for this reason is put on

the market as a natural product. The phosphoric acid—this is the only plant food of money value in it—in this phosphate is in the insoluble form and there is not enough present to justify manufacturers to treat it with acid to render the phosphoric acid available to plants.

It is to be noted that while the main office of the American Fertilizer Company is in Washington, D. C., the sample sent to this laboratory for analysis came from Fernandina, Fla.

VALUE OF "NATURAL PLANT FOOD?"

As has been seen from the analyses and from the experiments of farmers, "Natural Plant Food" has very little, if any agricultural value or *crop producing power*, and farmers should judge it solely from this standpoint. It has a commercial value of from $2 to $3 per ton at the mines, that is, it costs that much to get it out. This material was sold to farmers in this State last year for from $11 to $15 for No. 1, and $14 to $17 for No. 2, when good complete fertilizers could have been obtained for $16 to $18. The money spent for this material was thrown away. Numerous experiments have been made with natural—untreated—phosphates and Florida soft phosphate, and the results have shown, to state it mildly, that these phosphates are remarkably inferior to acid phosphate in crop producing power, and on most soils have given no immediate returns in increased crops.

WARNING TO FARMERS.

So far as "Natural Plant Food" and the American Fertilizer Company are concerned, we scarcely feel it necessary to have sent out the foregoing statement as we believe no more business will be done by this company in this material—certainly not in the sections where "Natural Plant Food" was tried last season. The company may, however, attempt to do business in some nook or corner of

the State where the character of their goods is not known, and where the question of fertilizers is not well understood. Then, too, fertilizers and fertilizing materials of questionable character, patent formulas for making crops grow, and such things will make their appearance on the market now and then, and it is with the two fold view of making the statement about "Natural Plant Food," and of warning farmers against buying fertilizers of questionable character and value that this bulletin is sent out.

There is always a plentiful supply of good fertilizers on sale in the State. It is the duty of this department to protect the buyers of fertilizers in the character of goods offered for sale. Our bulletins, containing information and analyses of fertilizers on sale, will be sent free to any person requesting them. In addition to the bulletins information by letter will be given about any fertilizer or fertilizing material that may be inquired about.

Mississippi Agricultural

EXPERIMENT STATION.

BULLETIN No. 44. JANUARY, 1898.

WINTER PASTURE.

E. R. LLOYD.

To encourage the farmers of the State to give more thought and attention to good pastures; to show what an easy matter it is to provide good grazing for stock during winter and early spring, the following report on the Winter Pastures of the Station is made. While we only report on Vetch, Turf Oats, and Alfalfa we have some Barley that is furnishing excellent grazing and Bur Clover or California Clover is beginning to cover the land with green.

Hairy Vetch.—The seed of this leguminous plant was first sown in 1888, and the Station began the distribution of the seed, in small quantities, in 1889–'90, and the plant has grown in greater favor each year since, and is now planted in large areas on many farms in the State for both winter grazing and for a hay crop. While we have obtained excellent results from the Vetch sown on brown loam and stiff clay soils, containing little lime, like most other plants of its family, it prefers a lime soil. We are not yet fully determined as to its adaptability to the light

sandy soils of the State. In a few instances it has given good results on these soils, but in the majority of cases Vetch has proven a failure when sown on light open sandy soils. Vetch has proven to be an excellent crop for either soiling, grazing or hay. Stock of all kinds are fond of Vetch, and the hay is richer in potien than clover hay, and is more digestible.

In September, 1893, we seeded one of our pasture lots containing one acre, to Vetch and Turf Oats. This lot was grazed by both hogs and cattle, from the middle of November to the 1st of May, when all stock was kept off the land. The crop was cut for hay May 17, and yielded one ton and seventy-two pounds of cured hay per acre. On the Station farm we have several fields of Vetch that were sown five years ago. These fields have yielded annually, about ten bushels of seed per acre. The seed ripen and are gathered in June. After the seed had been gathered each year, the land was plowed with two horse plow, and sown to Cowpeas, and we have never failed to get a large amount of excellent hay. With the first rains in the fall the Vetch seed, that had been shattered out on land, when Vetch was gathered, would come up, and grow off rapidly. This plant is not injured by cold or frost. The stand of Vetch on these fields is perfect, and about six inches high now. No seed have been put on this land in five years, except those wasted in harvesting the crop each year. There is no quicker or cheaper way in which to enrich our land, than by growing two leguminous crops (Vetch and Cowpeas) on it in the same season, and both of these crops utilized for stock food.

Turf Oats and Hairy Vetch.—We have gotten more and better grazing from these two plants when sown together, than from either when sown separately.

The seeding should be done in August or September, using one and a half bushels of Oats and one bushel of Vetch seed per acre. The preparation of land and seeding is same as for oats.

These two plants make a happy combination, both mature about same time, and while oats is exhaustive to land the Vetch is a renovating crop, and I think will add more fertility to the soil than will be removed by the oats.

We have not found a better combination than is furnished by these two plants for winter and early spring grazing. The Station has now about forty acres that is furnishing excellent grazing for our stock. The College Farm has over 100 acres in Oats and Vetch, about one-half of which is used for winter pasture and the remainder to be harvested for seed and feed.

Neither of these plants is injured by our coldest weather, and can be grazed from the middle of November until the 1st of April, and if a crop of seed or hay is desired, the stock should then be taken off the field, and the crop for hay will be ready to harvest by the middle of May, or a crop of seed can be harvested by the middle of June. The College Farm had, last year, fifty acres sown to Turf Oats and Vetch. The crop was harvested in June, and the yield of seed per acre was fifty bushels. The land on which this crop was grown was a fine peice of valley. After the crop was gathered the land was broken broadcast with a two-horse plow, and planted to Cowpeas. One part sown broadcast, and the other planted in drill. The broadcast peas were cut for hay in the fall, and those planted in the drill were cultivated and the peas gathered for seed.

During the harvesting of the Oats and Vetch in June, enough seed of both shattered out on the land to perfectly reseed the field. And with the first rains in the fall the seed of both Oats and Vetch came up, and now the land is perfectly covered with a green mat of Oats and Vetch to a depth of six inches, and is furnishing fine grazing for the cattle.

The Oats and Vetch can be sown in the cotton field at the last plowing, and after the cotton has been gathered, the Oats aud Vetch will furnish good grazing until spring.

when the land will be in fine condition for the spring planting. After the stock have grazed a field of Oats and Vetch during the winter, the seed will mature, and may be harvested in time to get a good corn crop from the same land the same season.

Alfalfa.—We have, invariably, secured better results from fall seeding than we have from spring seeding. If possible, the seed should be sown in August or September, at the rate of twenty pounds per acre. On account of the long drouths, we have had for the past few years, it has been very difficult to get the land in proper shape and the seed sown at right time. In the fall of 1896 we could not seed our land until October 31 for the above reason, and as a result of the late planting we got only two cuttings for hay last summer, when we should have had three heavy cuttings and one or two lighter ones, but the pasturage we had from this field, compensated in a measure, for the small hay yield. This meadow furnished excellent grazing for the dairy cows during November and December.

Great care should be taken in turning cattle or sheep on an Alfalfa pasture, for the reason that, this plant when young and tender or if wet from rains or heavy dews will bloat cattle or sheep. It does not have this affect on horses or hogs, and hogs will keep in good condition on Alfalfa pastures with little other feed.

When cattle or sheep are to be put on an Alfalfa meadow, they should be, well fed and watered, and allowed to remain on the meadow only a few hours at first. With this precaution, there will be little danger of bloat. This meadow presents a pretty sight now, the plants are from six to eight inches high and very vigorous. We have another field of Alfalfa sown October 14, 1897. This field is perfectly green and plants from four to six inches high.

The bulletins of this Station are sent free to all farmers in Mississippi who apply for them.

Address all communications to **Agricultural Experiment Station,** Agricultural College ,Miss.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

Special Bulletin No. 45.

Analyses of Commercial Fertilizers

ON SALE IN THE STATE.

Agricultural College, Miss., Feb. 15, 1898.

Mississippi Fertilizer Control.

INSPECTION AND ANALYSES OE FERTILIZERS

BY THE CHEMICAL DEPARTMFNT OF THE

MISSISSIPPI AGRICULTURAL AND MECHANICAL COLLEGE.

B. W. KILGORE, State Chemist.
W. F. HAND, Assistant Chemist.
E. W. MAGRUDER, Ass't. Chemist.
J. S. CARROLL, Ass't. Chemist.

The analyses presented in this bulletin are of samples of fertilizers collected by the fertilizer inspector of this Department. The samples were taken the latter part of December and in January from goods in the hands of fertilizer dealers, and therefore represent the composition of the goods the farmers *are buying or will buy.*

This is the second edition of the fertilizer bulletin for this season, 1897–'98. From now on till the end of the growing season the fertilizer inspector will make frequent trips over the portion of the State where fertilizers are used, and collect samples from goods in the dealer's hands. These samples will be analyzed as promptly as possible and the results published for the benefit of those interested in them. It is proposed to send out the third bulletin

NOTE.—The analysis and inspection of commercial fertilizers is by law done by the Professor of Chemistry in the College, who is the State Chemist. The results being considered of agricultural value are sent out by the Experiment Station. All communications in regard to these Bulletines or analyses should be addressed to State Chemist.

March 15th, the fourth April 15th, and the 5th, to include all the work of the season, some time during the summer. *These bulletins will be sent free to all persons requesting them.*

TERMS USED IN ANALYSES.

Nitrogen, Phosphoric Acid, and Potash are the three constituents in a fertilizer which give to it its value. They do not make up all of a fertilizer—in fact in most fertilizers other constituents are present in larger quantities than are these—but they are the only ones to which values need be assigned. The amounts of these constituents found in the fertilizers analyzed are expressed in the table as percentages or pounds in one hundred pounds of the fertilizer.

Four columns are given to phosphoric acid. In the first is found the water soluble phosphoric acid, or the portion dissolved by cold water: in the second one is found the citrate soluble, or the portion soluble in ammonium citrate solution; in the third the portion not soluble in either water or citrate solution, but soluble in strong acid; in the fourth column is given the total phosphoric acid, or the sum of the preceding forms. The water soluble and citrate soluble represent the phosphoric acid immediately available for plant growth.

Two sets of percentages are given in the table, "found" and "guaranteed." The percentages found represent the results actually obtained in the analysis of the fertilizers, while the guaranteed percentages are what the manufacturers claim them to contain.

VALUATIONS.

In order to have a basis of comparison for the different fertilizers valuations are assigned to the three valuable

ingredients--nitrogen, phosphoric acid, and potash. These valuations are not intended to represent *crop producing power or agricultural value*, but are *estimates of the commercial* value of nitrogen, phosphoric acid, and potash in the materials supplying them. While the valuations are only approximate, it is believed that they fairly represent the cost of making and putting the fertilizers on the market. They are based upon a careful examination of the trade conditions, wholesale and retail, and upon quotations from manufacturers.

The figures used in calculating the "relative value per ton" in this bulletin are practically the same as those used last season, and are as follows:

	per pound.
For Nitrogen	12.5 cents
For potash	5 cents
For water-soluble phosphoric acid in mixed fertilizers	5 cents
For water-soluble phosphoric acid in unmixed acid phosphates	4.5 cents
For citrate-soluble phosphoric acid in mixed fertilizers	4.5 cents
For citrate-soluble phosphoric acid in unmixed acid phosphates	4 cents
For phosphoric acid in fine ground bone	3 cents
For phosphoric acid in medium and coarse bone	2.5 cents

All relative values during this season will be calculated by the use of these figures.

HOW RELATIVE VALUES ARE CALCULATED.

It may not be clear to all how values per ton are calculated. To make this plain an example is given. It is to be remembered that the figures in the table represent

pounds and parts of a pound of nitrogen, phosphoric acid, and potash in one hundred pounds of the fertilizer, and that there are twenty hundred pounds in one ton (2,000 pounds.)

The calculation is made as follows:

Percentage or lbs. in 100.	Val. per 100 lbs.	Val. per ton (2,000 lbs.)
6 lbs. Water-sol. phos. acid at 5c per lb.	$0.30 x 20 =	$ 6 00
2 lbs. Citrate-sol. phos. acid at 4½c. per lb	0.09 x 20 =	1 80
2 lbs. Nitrogen at 12½ cents per pound...	0.25 x 20 =	5 00
2 lbs. Potash at 5 cents per pound.....	0.10 x 20 =	2 00
Total value.....	$0.74 x 20 =	$ 14.80

DATA IN THE TABLES.

The data in the tables will be readily understood. In table 1 will be found the analyses of samples collected this season. These goods are now on sale and the analyses should receive careful study as they show the character of the fertilizers being offered to the farmer. Several analyses are given of some of the brands, together with the dealers selling them, and under the analyses will be found the guarantees made by the manufacturers. A comparison of these will show how well the goods agree with the claims made for them.

Table II.

In table II will be found a list of the brands of fertilizers registered and legally on sale in the State, together with the guaranteed composition of the brands, and the relative values per ton calculated from these guarantees. Analyses of a large number of these brands have not yet been made as the goods were not found on sale when samples were collected.

Name of Brand and Manufacturer.	Where and From Whom Collected.
Manufactured by **Meridian Fertilizer Factory,** Meridian, Miss.	
STANDARD HOME MIXTURE	J McGrath & Sons, Brookhaven
" " "	Earns, Long & Co., Wesson
" " "	T. C. Vivaret & Bro., Newton
" " "	T. F. Abney & Son, Newton
" " "	W. B. Richardson, Newton
" " "	Guarantee
SOUTHERN SOLUBLE	Lampton Mer. Co., Magnolia
" "	Guarantee
BLOOD BONE AND B	Ford Bros. Co., Centreville
" " "	Guarantee
EARMERS' FRIEND	J. P. Meyer, Ellisville
" "	Bonner Bros. Sandersville
" "	Guarantee
SOUTHERN ACID PHOSPHATE	W. M. McGough, Morton
" " "	W. B. Richardson, Newton
" " "	G. W. Walton, Hickory
" " "	Guarantee
Manufactured by **Standard Guano & Chemical Co.,** New Orleans, La.	
AMMONIATED R. B. SUPERPHOSPHATE	C. Atkinson, Summit
" "	Hyman Mer. Co., Summit
" "	Earns, Long & Co., Wesson
" "	Guarantee
CHAMPION FARMER'S CHOICE	S. Wolf, Osyka
" "	Pfeifer & Dreyfus, Brookhaven
" "	Guarantee
BLOOD, BONE, AND MEAT GUANO	Hyman Mer. Co., Summit
" " "	Guarantee

Laboratory Number.	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Va ue per Ton.
		Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
616	13.35	7.97	1.86	.85	10.68	2.04	1.84	$16.58
617	13.39	8.00	2.13	.68	10.81	1.97	1.87	16.72
622	13.01	7.85	2.20	.77	10.82	1.90	1.99	16.57
623	15.79	7.89	2.10	.88	10.87	1.94	1.89	16.52
624	13.71	8.02	1.86	.80	10.68	1.92	1.92	16.41
....	.....	*7.75*	*2.00*	*1.00*	*10.75*	*1.75*	*1.85*	*15.78*
701	13.09	7.93	2.01	1.18	11.12	2.12	1.73	16.77
....	.....	*7.75*	*2.00*	*1.00*	*10.75*	*1.75*	*1.85*	*15.78*
696	12.21	7.33	1.72	4.81	13.86	1.98	1.87	15.70
....	.....	*7.75*	*2.00*	*1.00*	*10.75*	*1.75*	*1.85*	*15.78*
698	15.90	9.61	1.97	.77	12.39	1.47	1.58	16.64
699	14.65	10.25	1.99	1.10	13.34	1.38	1.50	16.99
....	.....	*8.00*	*2.50*	*1.00*	*11.50*	*1.25*	*1.50*	*14.88*
673	15.42	12.74	2.31	1.18	16.23	.....	.....	13.32
674	16.29	14.17	1.04	1.05	16.26	.....	.....	13.58
675	16.34	13.92	1.50	.44	15.86	.....	.....	13.73
....	.....	*12.50*	*2.00*	*.50*	*15.00*	.....	.....	*12.85*
632	12.74	7.42	1.94	1.80	11.16	1.73	1.64	15.13
633	13.78	7.46	2.29	1.15	10.90	1.76	1.45	15.37
634	13.25	7.27	3.07	.62	10.96	1.73	1.31	15.67
....	.....	*4.00*	*4.00*	*1.00*	*9.00*	*1.65*	*1.50*	*13.23*
706	10.78	6.84	2.28	1.46	10.58	2.16	1.81	16.10
707	11.65	6.56	2.63	.86	10.05	2.31	2 00	16.70
....	.....	*4.00*	*4.00*	*1.00*	*9.00*	*1.65*	*1.50*	*13.22*
700	11.58	8.25	2.05	1.38	11.68	1.90	2.89	17 74
....	.....	*4.00*	*4.25*	.....	.....	*1.70*	*2.00*	*14.07*

Name of Brand and Manufacturer.	Where and From Whom Collected.
GROUND BONE.....	Lotterhos & Huber, Cryst'l Spr's
" "	S. Wolf, Osyka .....
" "	Guarantee .....
ACID PHOSPHATE	Lampton Mer. Co., Magnolia ..
" "	J. P. Wise, Hazlehurst .....
" "	Guarantee .....
Manufactured by **Jackson Fertilizer Company,** Jackson, Miss.	
ROYAL C.....	Lotterhos & Huber, Cryst'l Spr's
"	C. Atkinson, Summit.....
"	Gallman Mer., Co , Gallman....
"	Earns, Long & Co., Wesson....
"	J. M. Stephenson, Morton.....
"	Guarantee .....
GULF STATES GUANO..	T. C. Simmons & Co., Magnolia
" " "	Guarantee.....
COMPLETE VEGETABLE AND FRUIT.....	Lotterhos & Huber, Cryst'l Spr's
" "	Gallman Mer. Co., Gallman....
" "	Guarantee .....
ACID PHOSPHATE.....	W. H. Chambliss, Newton .....
" "	Guarantee .....
Manufactured by **Capital Fertilizer Company,** Jackson, Miss.	
NONPAREIL	Factory .....
"	Becker, Lyell & McGrath Co., Wesson .....
"	Lampton Mer. Co., Magnolia...
"	M. J. L. Hoye's Sons, Newton.
"	Walton, Gillaspy & Russell, Hickory .....
"	Guarantee .....
RED STAR.....	John Parker, Terry.....
" "	Wm. Atkinson & McDonald, Wes.

Laboratory Number.	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value Per Ton.
		Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
709	4.02	.....	.....	.....	22.16	3.77	.....	20.50
710	4.52	.....	.....	.....	19.01	2.83	.....	16.58
....	.....	.....	.....	.....	*18.50*	*2.50*	.....	*15.50*
727	12.43	11.71	5.01	.92	17.64	.....	.....	14.55
728	13.81	10.85	5.51	1.87	18.23	.....	.....	14.17
....	.....	*10.00*	*2.00*	*1.00*	*13.00*	.....	.....	*10.60*
625	19.82	7.71	2.05	.93	10.69	1.82	1.76	15.27
626	17.66	8.05	2.02	.61	10.68	1.89	1.93	16.53
627	17.20	7.52	2.10	.81	10.43	1.99	1.90	16.29
628	19.99	7.51	2.09	.79	10.39	1.73	1.81	15.53
629	15.31	8.02	2.05	.84	10.91	1.81	1.95	16.35
....	.....	*6.00*	*1.60*	*1.00*	*8.60*	*1.55*	*1.80*	*13.13*
708	19.86	7.52	2.11	.90	10.53	1.80	1.82	15.74
....	.....	*6.00*	*1.60*	*1.00*	*8.60*	*1.55*	*1.80*	*13.12*
630	7.61	5.10	1.58	1.20	7.88	3.31	5.76	20.56
631	7.45	5.01	2.55	.50	8.06	3.69	4.61	21.14
....	.....	*3.00*	*3.00*	*1.00*	*7.00*	*3.00*	*4.00*	*17.20*
677	13.05	13.32	3.65	1.11	18.08	.....	.....	14.91
....	.....	*12.50*	*2.00*	*1.00*	*15.50*	.....	.....	*12.85*
615	11.46	8.41	2.26	.72	11.39	1.73	2.20	16.97
618	11.87	7.79	2.31	.62	10.72	1.56	2.03	15.80
619	11.50	8.27	1.94	.74	10.95	1.88	2.10	16.82
620	11.21	5.06	4.98	.50	10.54	1.47	2.30	15.52
621	12.35	8.31	2.05	.71	11.07	1.64	2.08	16.34
....	.....	*6.00*	*1.00*	*.50*	*7.50*	*1.50*	*1.75*	*12.40*
705	10.42	6.83	3.23	.64	10.70	1.67	2.26	16.18
711	11.02	8.00	1.78	1.29	11.07	1.69	1.97	15.80

Name of Brand and Manufacturer.	Where and From Whom Collected.
RED STAR.....	Guarantee .....
MISSISSIPPI STATE GRANGE	T. M. Eagan, Crystal Springs .
" "	Guarantee .....
VEGETABLE GROWER ...	W. S. Howard's & Co., Hazleh't
" "	Kemp & Abrams, Hazlehurst ..
" "	Guarantee .....
PRODUCER.....	T. C. Vivaret & Bro., Newton..
"	Guarantee .....
KAINT.....	Ford Bros. Co., Centreville....
"	W. H. Barron & Co., Cryst'l Sp'gs
"	Guarantee .....
PURE BONE MEAL.....	Factory .....
" " "	Lampton Mer. Co., Magnolia...
" " "	Guarantee .....
ACID PHOSPHATE.....	I. M. Eagan, Crystal Springs ..
" "	Walton, Gillaspy & Russell,
	Hickory .....
" "	Guarantee .....
Manufactured by **Mobile Phosphate and Chemical Co.** Mobile, Ala.	
MOBILE STANDARD.....	W. M. Hyde, Vossburg.....
" "	W. H. Chambliss, Newton .....
" "	Winner & Meyer, Meridian....
" "	Guarantee .....
K. K. K. AMMONIA'D BONE	Hawkins & Co., Hattiesburg...
"	J. L. Moyse & Bro., Summit...
"	Guarantee .....
ECLIPSE SOLUBLE GU'NO	M. J. L. Haye's Sons, Newton..
" " "	Guarantee .....
I. X. L. ACID PHOSPHATE	Wm. Atkinson & McDonald, Wes.
" " "	T. C. Simmons & Co., Magnolia.
" " "	Guarantee .....

Laboratory Number.	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value per Ton.
		Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
....	.....	*6.00*	*1.00*	*.50*	*7.50*	*1.50*	*1.75*	*12.40*
715	12.62	7.15	2.95	.81	10.91	1.91	2.07	16.65
....	.....	*6.00*	*1.00*	*.50*	*7.50*	*1.50*	*1.75*	*12.40*
712	9.50	5.85	2.35	.78	8.98	2.54	5.93	20.27
713	9.12	5.78	2.33	.63	8.74	2.85	5.86	20.86
....	.....	*5.00*	*2.00*	*.50*	*7.50*	*2.50*	*3.00*	*16.05*
714	11.66	7.36	1.55	.90	9.81	1.68	2.44	15.40
....	.....	*6.00*	*2.00*	*.50*	*8.50*	*1.50*	*1.75*	*13.30*
716	4.79	.....	.....	.....	.....	.....	12.18	12.18
717	6.93	.....	.....	.....	.....	.....	12.08	12.08
....	.....	.....	.....	.....	.....	.....	*12.00*	*12.00*
638	4.46	.....	.....	.....	27.70	2.28	.....	22.32
637	5.60	.....	.....	.....	27.26	2.27	.....	22 08
....	.....	.....	.....	.....	*25.00*	*2.25*	.....	*20 63*
639	12.11	12.51	3.83	.88	17.22	.....	.....	14.33
676	11.65	10.12	4.92	1.06	16.10	.....	.....	13.05
....	.....	10.00	2.00	.....	.....	.....	.....	10.60
692	10.97	7.07	2.52	1.40	10.99	2.08	2.34	16.87
723	10.31	6.06	2.56	1.54	10.16	2.11	2.21	15.86
635	12.86	7.80	1.30	.98	10.08	2.03	2.39	16.44
....	.....	*6.00*	*2.00*	*1.50*	*9.50*	*1.65*	*2.00*	*13.93*
690	12.94	8.15	1.72	.95	10.82	1.39	1.54	14.72
691	12.85	7.57	2.24	1.05	10.86	1.39	1.60	14.67
....	.....	*8.75*	*1.25*	*1.50*	*11 50*	*.85*	*1.00*	*13.01*
726	13.21	8.19	2.02	1.16	11.37	2.01	2.32	17.36
....	.....	*8.00*	*1.25*	*1.50*	*10.75*	*1.45*	*1.50*	*14.25*
724	12.76	10.91	2.80	1.73	15.44	.....	.....	12.06
725	12.75	10.55	3.37	2.57	16.49	.....	.....	12.20
....	.....	*10.00*	*2.00*	*1.50*	*13.50*	.....	.....	*10.60*

Name of Brand and Manufacturer.	Where and From Whom Collected.
Manufactured by **Armour Packing Company,** Kansas City, Mo.	
FERTILIZER NO. 271....	W. L. Wellman, Wesson.....
" "	Guarantee.....
FERTILIZER NO. 386....	Lotterhos & Huber, Cryst'l Spr's
" "	Guarantee.....
Sold by **Marbach & Eagan,** Crystal Springs, Miss.	
BAT GUANO.....	Robinson Mer. Co., Centreville.
" "	W. J. Davis, Terry.....
" "	Guarantee.....
Manufactured by **Planters' Fertilizer Company,** New Orleans, La.	
COTTON AND CORN FER.	Boyd & Lee, Wesson.....
" " "	Guarantee.....
Manufactured by **Threefoot Bros. & Co.,** Meridian, Miss.	
THREEFOOT'S IMPROVED MIXTURE.....	.....
" "	Guarantee.....
HIGH GRADE ENGLISH ACID PHOSPHATE.....	J. L. Wells, Hickory.....
" " "	Guarantee.....

Laboratory Number.	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value per Ton.
		Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
693	2.89	4.44	2.84	.70	7.98	1.42	1.11	$11.66
....	.....	*5.00*	*2.00*	*1.50*	*8.50*	*1.50*	*1.00*	*11.55*
694	4.45	5.16	3.08	1.47	9.71	2.41	6.34	20.29
....	.....	*5.00*	*3.00*	*2.00*	*10.00*	*2.50*	*6.00*	*19.95*
718	18.80	.....	.....	.....	11.49	4.52	.69	18.88
719	20.08	.....	.....	.....	9.93	4.81	.63	18.62
....	.....	.....	.....	.....	*5.00*	*4.50*	*.75*	*15.00*
720	11.82	6.67	1.51	.06	8.24	2.22	1.65	15.23
....	.....	*7.00*	*1.50*	*.15*	*8.65*	*2.00*	*2.00*	*15.35*
722	10.82	8.19	2.73	.74	11.66	2.03	2.16	17.88
....	.....	*8.00*	*2.00*	.....	.....	*1.77*	*1.99*	*16.13*
721	15.04	11.51	4.08	.73	16.32	.....	.....	13.62
....	.....	*12.50*	.....	*2.50*	.....	.....	.....	*13.25*

TABLE II.—Brands of Fertilizers Registered for Sale in the State, with Guarantees for Season 1897-'98.

Name of Brand and Address of Manufacturer.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value Per Ton.
	Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
Standard Guano & Chemical Manufacturing Co., New Orleans, La.							
Wolf's Ammoniated R. B. Superphosphate...	4.00	4.00	1.00	9.00	1.65	1.50	$13 22
Stern's Ammoniated R. B. Superphosphate..	4.00	4.00	1.00	9.00	1.65	1.50	13 22
Standard Ammoniated Soluble Guano	4.00	4.00	1.00	9.00	1.65	1.50	13 22
Champion Farmer's Choice.....	4.00	4.00	1.00	9.00	1.65	1.50	13 22
Mississippi Home Guano.....	4.00	5.00	1.00	10.00	1.65	2.00	14 62
Blood Bone and Meat Guano.....	4.00	4.25	.....	.....	1.70	2.00	14 07
I. C. Diamond Brand.....	4.00	4.00	1.00	9.00	1.65	1.50	13 22
Pelican Raw Bone Guano.....	4.00	4.00	1.00	9.00	1.65	1.50	13 22
Ground Bone.....	.....	.....	.....	18.50	2.50	.....	17 35
Acid Phosphate.....	10.00	2.00	1.00	13.00	.....	.....	10 60
Kainit.....	.....	.....	.....	.....	.....	12.00	12 00
Meridian Fertilizer Factory, Meridian, Miss.							
Standard Home Mixture Guano.....	7.75	2.00	1.00	10.75	1.75	1.85	15 78

Southern Soluble Guano	7.75	2.00	1.00	10.75	1.75	1.85	15 78
Blood Bone and B. Guano	7.75	2.00	1.00	10.75	1.75	1.85	15 78
Farmer's Friend Guano	8.00	2.50	1.00	11.50	1.25	1.50	14 88
High Grade Vegetable Grower	5.00	1.00	.50	6.50	2.50	6.00	18 15
Southern Acid Phosphate	12.50	2.00	.50	15.00	.....	.....	12 85
Kainit	.....	.....	.....	.....	.....	12.00	12 00
Bone and Potash	8.00	2.50	.....	.....	.....	3.00	13 25
Jackson Fertilizer Company, Jackson, Miss.							
Royal C. Brand	6.00	1.60	1.00	8.60	1.55	1.80	13 12
Gulf States Guano	6.00	1.60	1.00	8.60	1.55	1.80	13 12
Vegetable and Fruit	3.00	3.00	1.00	7.00	3.00	4.00	17 20
Lotterhos & Huber's Tomato Grower	6.00	4.00	1.00	11.00	2.40	1.00	16 60
Kainit	.....	.....	.....	.....	.....	10.00	10 00
Acid Phosphate	12.50	2.00	1.00	15.50	.....	.....	12 85
Capital Fertilizer Company, Jackson, Miss.							
Nonpareil	6.00	1.00	.50	7.50	1.50	1.75	12 40
Red Star	6.00	1.00	.50	7.50	1.50	1.75	12 40
Producer	6.00	2.00	.50	8.50	1.50	1.75	13 30
Mississippi State Grange	6.00	1.00	.50	7.50	1.50	1.75	12 40
Vegetable Grower	5.00	2.00	.50	7.50	2.50	3.00	16 05
Raw Bone Meal	.....	.....	.....	25.00	2.25	.....	20 63
Acid Phosphate	10.00	2.00	.....	.....	.....	.....	10 60
Kainit	.....	.....	.....	.....	.....	12.00	12 00
Mobile Phosphate & Chemical Manufacturing Co., Mobile, Ala.							
Mobile Standard	6.00	2.00	1.50	9.50	1.65	2.00	13 93

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Name of Brand and Address of Manufacturer.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value Per Ton.
	Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
K. K. K. Ammoniated Bone	8.75	1.25	1.50	11.50	.85	1.00	13 01
Eclipse Soluble Guano	8.00	1.25	1.50	10.75	1.45	1.50	14 25
Kainit	.....	.....	.....	.....	.....	12.00	12 00
I. X. L. Acid Phosphate.	10.00	2.00	1.50	13.50	.....	.....	10 60
Southern Fertilizer Company, Atlanta, Ga.							
Scott's Gossypium Phospho	6.00	3.00	1.00	10.00	2.05	2.00	15 83
Scott's Potasso Phospho	10.00	3.00	1.00	14.00	.....	2.00	14 70
Scott's Animal Ammoniated Guano	6.00	3.00	1.00	10.00	1.65	1.00	13 83
Scott's Acid and Meal Formula	7.00	3.00	1.00	11.00	.83	1.00	12 78
Scott's High Grade Acid Phosphate	11.00	3.00	1.00	15.00	.....	.....	12 30
Armour Packing Company, Kansas City, Mo.							
Blood Bone and Potash	6.00	3.00	2.00	11.00	4.50	7.00	26 95
Fertilizer No. 386	5.00	3.00	2.00	10.00	2.50	6.00	19 95
Fertilizer No. 271	5.00	2.00	1.50	8.50	1.50	1.00	11 55

Fertilizer No. 272	5.00	2.00	1.50	8.50	1.50	2.00	12 55
Fertilizer No. 281	5.50	2.50	1.50	9.50	1.50	1.00	12 55
Fine Ground Beef Bone	.....	12.50	12.50	25.00	2.50	.....	23 75
Cotton Grower	5.50	2.50	1.50	9.50	1.50	.....	11 50
Planters' Fertilizer Company. New Orleans, La.							
Cotton and Corn Fertilizer	7.00	1.50	.15	8.65	2.00	2.00	15 35
Marbach & Eagan. Crystal Springs, Miss.							
Bat Guano	.....	.....	.....	5.00	4.50	.75	15 00
Tennessee Chemical Co., Nashville, Tenn.							
Ox Brand High Grade Guano	8.00	2.00	1.00	11.00	2.00	1.25	16 05
Ox Brand Cotton Guano	8.00	2.00	1.00	11.00	1.65	1.00	14 93
Ox Brand Ammoniated Bone	8.00	2.00	1.00	11.00	1.65	2.00	15 93
Ox Brand Bone with Ammonia and Potash	8.00	2.00	1.00	11.00	.82	1.00	12 82
Ox Brand Bone and Potash	9.00	3.00	1.00	13.00	.....	1.00	12 70
Ox Brand High Grade Dis. Bone	11.00	3.00	1.00	15.00	.....	.....	12 30
Goulding Fertilizing Company. Pensacola, Fla.							
Goulding's Bone Compound	8.00	2.00	2.00	12.00	1.65	1.50	15 43
Goulding's Acid Phosphate	13.00	2.00	1.00	16.00	.....	.....	13 30
New Orleans Acid and Fertilizer Co., New Orleans, La.							
Goldsmith's Improved Mixture	7.25	2.10	1.50	10.85	1.92	1.00	14 94
Gold Dust for Cotton and Corn	7.25	2.10	1.50	10.85	1.92	1.00	14 94
Horse Shoe Fertilizer	7.25	2.10	1.50	10.85	1.92	1.00	14 94
Black Diamond Acid Phosphate	10.00	2.00	2.00	14.00	.....	.....	10 60
Crescent City Acid Phosphate	10.00	2.00	2.00	14.00	.....	.....	10 60

TABLE II.—Brands of Fertilizers Registered for Sale in the State, with Guarantees for Season 1897-'98.

Name of Brand and Address of Manufacturer.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value Per Ton.
	Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
Threefoot Bros. & Co., Meridian, Miss.							
Threefoot's Improved Mixture	8.00	2.00	.....	.....	1.77	1.90	$16 13
High Grade English Acid Phosphate	12.50	2.50	.....	.....	.....	.....	13 25
Pacific Guano Co., Charleston, S. C.							
Soluble Pacific Guano	6.50	2.00	2.00	10.50	1.75	1.00	13 68
Birmingham Fertil'r Co., Birmingham, Ala.							
Birmingham High Grade B.B. and Potash	7.00	2.00	2.00	11.00	1.64	2.00	14 90
Boss Guano	7.00	2.00	2.00	11.00	1.64	2.00	14 90
Birmingham High Grade Dissolved Bone	11.00	2.00	2.00	15.00	.....	.....	11 50
Birmingham High Grade Acid Phosphate	11.00	2.00	2.00	15.00	.....	.....	11 50
Prolific Acid Phosphate	11.00	2.00	2.00	15.00	.....	.....	11 50
A. D. Adair & McCarty Bros., Atlanta, Ga.							
Buffalo Bone Fertilizer	6.00	3.00	2.00	11.00	1.75	1.00	14 08
Furman's Soluble Bone	6.00	4.00	2.00	12.00	.85	1.00	12 73
Farish Furman Formula	6.00	4.00	2.00	12.00	.....	2.00	11 60
Furman High Grade Dissolved Bone	8.00	4.00	2.00	14.00	.....	.....	10 40
P. B. Mathiason M'f'g. Co., St. Louis, Mo.							
Vegetable Fertilizer	3.50	4.50	1.50	9.50	3.75	2.00	18 93
Two and Eight	4.00	4.00	.....	.....	1.65	.....	11 73
Pure Bone Meal	.....	.....	.....	21.00	3.20	.....	18 50
Bradley Fertilizer Co., Charleston, S. C.							
B. D. Sea Fowl Guano	6.50	2.50	2.00	11.00	1.85	1.00	14 38

ANALYSES and GUARANTEES

—OF—

FERTILIZERS

ON SALE IN MISSISSIPPI.

Second Monthly Edition, Season 1897-'98.

These bulletins will be sent free to any address upon application to State Chemist.

Mississippi Agricultural

EXPERIMENT STATION.

BULLETIN No. 46. MARCH, 1898.

CO-OPERATIVE EXPERIMENTS WITH SMALL FRUIT.

DR. D. T. PRICE, Booneville, Miss.

While many of the Southern States are giving a great deal of attention to the growing of the different small fruits for home use, and for market, in only a few localities has this industry received much attention in Mississippi. Our home markets being supplied largely with berries shipped in from adjoining States. This is especially true of Northeast Mississippi. Wherever small fruits have been grown for market the acreage has been increased, year by year, giving evidence of the fact that there are larger expectations of profit in this than in the lines of staple agriculture. To encourage a more general cultivation of these luxuries for our own tables, if not for market, is the chief aim of this Bulletin.

Proper preparation of the land, careful selection of varieties, timely and most economic methods of cultivation, intelligence in gathering, handling and shipping, and applications of suitable plant foods at the proper time, are the necessary conditions of success. To comply with these conditions has been my aim; knowing that quality and

condition of fruits when received in the market determine their commercial value.

Stawberries.—This deserving fruit has received, and is receiving, by far the greatest share of public attention. It is the first fresh fruit to come to our tables in the spring, the first to go on the markets, and therefore the first to put money into our pockets. Beautiful to the eye, tempting to the appetite, luscious and wholesome as food for our bodies, are qualities which easily make it the most popular small fruit.

The strawberry plant requires a liberal supply of water and a water-holding capacity of the soil. The best soil, therefore, is a moderately heavy clay loam underlaid with a good, stiff clay subsoil. This soil should contain enough vegetable matter to prevent too close compacting and assist in retaining moisture. For field culture of strawberries it has been found best to plant on slightly elevated ridges, to facilitate cultivation mainly. These ridges should be high in proportion to dampness and water-retaining properties of the soil. The rows should be three and a half to four feet apart. Set plants according to their habits of growth. Rampant growing varieties like Michel, Crescent and Cloud may be set twenty-four to thirty inches apart, while fifteen to twenty inches apart in the row is best for such varities as Wilson, Lovett and Bubach. The matted row system is considered best in the South, and as the strawbery makes provision in the growth of one season for the fruit crop of the next—the chief aim in cultivation should be to secure a properly matted row of healthy and well developed plants.

About eighteen inches across, with plants standing four to six inches apart is considered an ideal row. If plants set too thickly, thin them out in late fall or early winter.

When there is ample moisture in the soil throughout the growing season it is easy enough to grow this ideal matted row of plants, but in the absence of facilities for irrigation when we have such protracted summer and fall drouths, accompanied by such intense sun-heat as we have

had the past two years, the growing of this ideal row can not be accomplished. The very best way to guard against the damaging effects of drouth is thorough preparation of the land when planting new beds, or in renovating old ones, and afterwards frequent shallow cultivations, maintaining a dust mulch to prevent the evaporation of water from the soil being the best, cheapest and most practicable mulch for the South. The fall season is probably the best time to set plants in Mississippi when there is sufficient moisture in the soil to insure the growth of plants. The land can usually be better prepared; work in other lines is not so pressing, besides if the planting is made in early fall the next spring crop of berries will more than pay for all expense of planting. Planting, however, may be done all through the winter and early spring months, but not so late as to prevent growth of plants from becoming well established before hot, dry weather sets in. In the application of fertilizers there is very little danger of using too much phosphoric acid and potash, but a too free use of nitrogen causes rank plant growth, and the fruit on such plants will be too soft and poorly colored to have much commercial value.

The varieties and names of strawberries run up into the hundreds, but it will be found in a careful variety test that there are very few kinds that do extra well in any one locality, or—at most—in any considerable area of country. soil characteristics, climatic and meteorological conditions —of course—make the difference. The above fact emphasizes the importance of Sub-Station Experimental work, and in order that the greatest number of people may derive the greatest amount of good from our State Experimental work, I believe there should be a Sub-Station—at least—in each Congressional District of the State, not necessarily for testing varieties of fruits, but along the lines of industries in which the people of each section are most interested. My work at Booneville was begun five years ago, and first and last, I have tested the merits of about fifty varieties of strawberries—keeping some varieties on

trial two years, others three and four years. All have been measured by the old tried and standard varieties Wilson, Crescent, Chas. Downing and Cumberland, with only a few exceptions all these varieties have failed to equal the old standards in desirable qualities. Some proved to be too soft and poorly flavored, some too small, some too uneven in size and irregular in shape, while others have ripened up unevenly, with hard, green tips, shy bearers, rusted foliage, etc.

I have worried a good deal over my failure with varieties whose merits have been so loudly praised by their introducers, but I have been somewhat comforted by the fact that the sesame varieties have—nearly all of them—behaved similarly, and have shared the same fate at all the experimental stations. It is disappointing, and surprising too, to know that out of the many hundreds of varieties introduced so very few of them possess sufficient merits to establish them as recognized standard sorts.

As a result of my work I can only recommend the following named varieties for general planting in Northeast Mississippi considered most valuable in the order named: Lady Thompson, Crescent, Bubach, Tennessee, Prolific, Brandywine, and Lovett. We must have a better early variety than Michel, and a better late variety than Gandy. When will we have an ideal, all purpose berry, equally well adapted to all sections, and under all climatic conditions? Never.

Raspberries.—This valuable fruit follows strawberries in time of ripening, and usually has a higher commercial value. My variety tests of this fruit have been quite limited, having had on trial only the following varieties: Turner, Thompson's Early and Gladstone (Red) and Nemeha, Palmer and Gregg (Black). Turner has done well, and Gregg fairly well. The other varieties have proven to be almost worthless here. Raspberries do well on the same soil recommended for strawberries, but I believe they would do better on a somewhat lighter soil. Rows should be four to five feet apart, and plants set two or three feet

in the row. The land should receive thorough preparation before planting, and afterwards frequent shallow cultivation through the spring and summer months. Pinch the canes back during the growing season so they will require no staking. Prune bearing canes in winter, and remove and burn all dead ones. Fertilize as needed. Thin out plants to four to six to the hill.

Blackberries.—The wild blackberry is so common in Mississippi that little attention has been given the domesticated ones. Yet there is no bush fruit which should be more generally grown. It follows raspberries and is the last one of the small fruits to ripen, furnishing our tables well into the summer with no mean dessert. I doubt its value in Mississippi as a commercial crop, shipped to the Northern markets they suffer from competition with strawberries and raspberries, and in the South they seem to be regarded as common property, and even in our cities the people don't like to pay money for them. The cultivated sorts are much larger, and of better quality than those growing wild, and are very easily grown.

Any one who will go to the small trouble and expense of planting a small patch will enjoy many a pie, roll, or dumpling he will miss if he depends on marauding the old fields or his neighbor's fence corners for his supply. The blackberry, to do its best, requires a great deal of water, and as it ripens its fruit at a time when drouth is liable to seriously damage the crop, they should be planted on the best moisture-retaining soil to be had. Cultivate frequently till fruit begins to ripen and once after crop has been gathered. A most excellent way to prevent evaporation of water from the soil is to cultivate well in the spring, and then cover the ground well with a mulch of forest leaves or old corn stalks. The rows should be 7 or 8 feet apart and plants set two to three feet apart in the row. Pinch the buds out of growing canes when about three feet high, this causes laterals to be thrown out. Let these latterals or branches grow as long as they will, but the next winter cut them back to from twelve to eigh-

teen inches, at the same time cut away all dead canes which bore the previous summer's crop and burn them. Keeping the patch or field clear of rubbish is the best way to keep the bushes free from disease. It is said that a blackberry patch well cared for will last almost indefinitely. Four to six canes from each root is plenty thick, and if more than this number start in the spring they should be kept pulled off when only a few inches high. I have had on trial five varieties, Dallas, Snyder, Erie, Lawton, and Taylor ripening in the order named. All have done well, and given a succession of luscious berries for about six weeks. So far they have been entirely free from disease.

Grapes.—In reviewing my work, I feel that it would be inexcusably incomplete without giving briefly my experience with "The Fruit of the Vine." This small vineyard of thirty-three varieties, three vines of each variety, has elicited expressions of wonder, and admiration from all who have seen it. It has been an object lesson which is bringing the lurcious clusters of this wholesome, and most popular fruit into hundreds of appreciative homes. Nearly every one of the thirty-three varieties have done well, demonstrating the fact that the grape is less sensitive to soil and climatic conditions than any other one of our cultivated fruits, varieties having their origen in the Northern and Eastern states do well even on our Gulf coast.

Most all of the varieties tested by me originated by T. V. Munson, of Denison, Texas, have done exceptionally well, and especially Big Extra, R. D. Munson, Dr. Collier, Rommel, Gold Coin, and Brilliant, of other sorts Champion, Progress, Ives, Lutie, Perkins, Concord, Niagara, Brighton, Triumph, Moore's Early, Missouri Reissling, and Pocklington have done best, Diamond Sun-blisters, I think sacking would prevent this. Eaton and Worden ripen too uneavenly to be valuable for marketing. Of the varieties tested Pocklington, Triumph, and Reissling are the best late sorts. Moore's Early the best very early. My little experimental vineyard was planted in the springs of 1893-

'94 according to directions given in Bulletin No. 22, Mississippi Experiment Station, by Prof. Tracy. This Bulletin is worth more than its weight in gold to any one engaging in grape culture. It is so explicit in every detail that I deem it useless to give more than a brief summary of its instructions for planting in this bulletin.

Plant vines eight feet apart each way. Run rows North and South. Dig holes eighteen inches square, and at least fifteen inches deep. If to be had, put five to eight pounds of old bones in the bottom of each hole, fill the holes with good top soil and pulverize it as well as possible. One year old vines from cuttings are best, but two years old will do. The planting should be done as much as possible with the hands. Place the roots as nearly as possible in their natural position, and fill around them closely with good soil which is fine and mellow. At planting, cut the vine back to two buds immeeiately above the top of the original cutting, so the new growth will start from very near the ground. When the buds are well started nub off all except the strongest looking one, thus growing but one vine which should be kept tied, up as it lengthens, to a five foot stake set at the time of planting. It is best to trellis at once, but if work is pressing this may be deferred till summer or fall. The horizontal trellis is recommended. In making it, the posts are set sixteen feet apart, saw tops off square five or six feet from the ground. A cross piece of 2x4, two feet long is laid on the top of each post, and securely nailed at right angles to the direction of the row. Three No. 12 galvanized wires are stapled to these cross-pieces, one directly over the posts, and the others one inch from the ends of the cross pieces. When the growth of the vine has reached the center wire pinch off the top. The formation of laterals or branches now begins, and they should be so pinched back and directed as to cover all three of the wires with healthy bearing canes or vines. Very little summer pruning is done with the knife, but prune frequently with

thumb and finger. The ends of the bearing shoots are pinched off two or three leaves beyond the last cluster of fruit, and most of the barren shoots are removed. The important point to be remembered in pruning is, that all the fruit is made on wood which grew during the previous year, and enough of this should always be left to bear a full crop. Prune early in winter to avoid bleeding. Cut back the bearing shoots to from two to four joints according to the number of them on each vine. As no very explicit directions can be given for pruning in all cases, every grower must exercise his own intelligent judgment in the matter. If bones have been used as directed, a shovelful of wood ashes to the vine every year or two will be sufficient fertilizing, otherwise fertilize as needed, making sure that enough potash and phosphoric acid are used. Cultivate sufficiently often and thorough to keep the soil mellow and free from weeds.

The bulletins of this Station are sent free to all farmers in Mississippi who apply for them.

Address all communications to **Agricultural Experiment Station,** Agricultural College ,Miss.

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

Special Bulletin No. 47.

Analyses of Commercial Fertilizers

ON SALE IN THE STATE

Agricultural College, Miss., March 25, 1894

Mississippi Fertilizer Control.

INSPECTION AND ANALYSES OE FERTILIZERS

BY THE CHEMICAL DEPARTMENT OF THE

MISSISSIPPI AGRICULTURAL AND MECHANICAL COLLEGE.

B. W. KILGORE, State Chemist.
W. F. HAND, Assistant Chemist.
E. W. MAGRUDER, Ass't. Chemist.
J. S. CARROLL, Ass't. Chemist.

The analyses presented in this bulletin are of samples of fertilizers collected by the fertilizer inspector of this Department. The samples were taken the latter part of December and in January, February, and March from goods in the hands of fertilizer dealers and therefore represent the composition of the goods the farmers *are buying or will buy*.

This is the third edition of the fertilizer bulletin for this season, 1897-'98. From now on till the end of the growing season the fertilizer inspector will make frequent trips over the portion of the State where fertilizers are used, and collect samples from goods in the dealer's hands. These samples will be analyzed as promptly as possible and the results published for the benefit of those interested in them. It is proposed to send out the fourth bulletin

Note.—The analysis and inspection of commercial fertilizers only is done by the Professor of Chemistry in the College, who is State Chemist. The results being considered of agricultural value are sent out by the Experiment Station. All communications in regard to these Bulletins or analyses should be addressed to State Chemist.

May 1th, and the 5th, to include all the work of the season, some time during the summer. *These bulletins will be sent free to all persons requesting them.*

TERMS USED IN ANALYSES.

Nitrogen, Phosphoric Acid, and Potash are the three constituents in a fertilizer which give to it its value. They do not make up all of a fertilizer—in fact in most fertilizers other constituents are present in larger quantities than are these—but they are the only ones to which values need be assigned. The amounts of these constituents found in the fertilizers analyzed are expressed in the table as percentages or pounds in one hundred pounds of the fertilizer.

Four columns are given to phosphoric acid. In the first is found the water-soluble phosphoric acid, or the portion dissolved by cold water; in the second one is found the citrate-soluble, or the portion soluble in ammonium citrate solution; in the third the portion not soluble in either water or citrate solution, but soluble in strong acid; in the fourth column is given the total phosphoric acid, or the sum of the preceding forms. The water-soluble and citrate-soluble represent the phosphoric acid immediately available for plant growth.

Two sets of percentages are given in the table, "found" and "guaranteed." The percentages found represent the results actually obtained in the analysis of the fertilizers, while the guaranteed percentages are what the manufacturers claim them to contain.

VALUATIONS.

In order to have a basis of comparison for the different fertilizers valuations are assigned to the three valuable

ingredients nitrogen, phosphoric acid, and potash. These valuations are not intended to represent *crop producing power or agricultural value*, but are *estimates of the commercial* value of nitrogen, phosphoric acid, and potash in the materials supplying them. While the valuations are only approximate, it is believed that they fairly represent the cost of making and putting the fertilizers on the market. They are based upon a careful examination of the trade conditions, wholesale and retail, and upon quotations from manufacturers.

The figures used in calculating the "relative value per ton" in this bulletin are practically the same as those used last season, and are as follows:

	per pound
For Nitrogen	12.5 cents
For potash	5 cents
For water-soluble phosphoric acid in mixed fertilizers	5 cents
For water-soluble phosphoric acid in unmixed acid phosphates	4.5 cents
For citrate-soluble phosphoric acid in mixed fertilizers	4.5 cents
For citrate-soluble phosphoric acid in unmixed acid phosphates	4 cents
For phosphoric acid in fine ground bone	3 cents
For phosphoric acid in medium and coarse bone	2.5 cents

All relative values during this season will be calculated by the use of these figures.

HOW RELATIVE VALUES ARE CALCULATED.

It may not be clear to all how values per ton are calculated. To make this plain an example is given. It is to be remembered that the figures in the table represent

pounds and parts of a pound of nitrogen, phosphoric acid, and potash in one hundred pounds of the fertilizer, and that there are twenty hundred pounds in one ton (2,000 pounds.)

The calculation is made as follows.

Percentage or lbs. in 100	Val. per 100 lbs.	Val. per ton (2,000 lbs.)
6 lbs. Water-sol. phos. acid at 5c per lb.	$0.30 x 20 =	$ 6.00
2 lbs. Citrate sol. phos. acid at 4c per lb.	0.08 x 20 =	1.60
2 lbs. Nitrogen at 12½ cents per pound.	0.25 x 20 =	5.00
2 lbs. Potash at 5 cents per pound.	0.10 x 20 =	2.00
Total value	$0.73 x 20 =	$ 14.60

DATA IN THE TABLES.

The data in the tables will be readily understood. In table 1 will be found the analyses of samples collected this season. These goods are now on sale and the analyses should receive careful study as they show the character of the fertilizers being offered to the farmer. Several analyses are given of some of the brands, together with the dealers selling them, and under the analyses will be found the guarantees made by the manufacturers. A comparison of these will show how well the goods agree with the claims made for them.

Table II.

In table II will be found a list of the brands of fertilizers registered and legally on sale in the State, together with the guaranteed composition of the brands, and the relative values per ton calculated from these guarantees. Analyses of a number of these brands have not yet been made as samples of the goods have not been obtained.

TABLE I.—Analyses of Commercial Fertilizers

Name of Brand and Manufacturer.	Where and From Whom Collected.
Manufactured by **Meridian Fertilizer Factory,** Meridian, Miss.	
STANDARD HOME MIXTURE	J. McGrath & Sons, Brookhaven
" " "	Earns, Long & Co., Wesson
" " "	T. C. Vivaret & Bro., Newton
" " "	T. F. Abney & Son, Newton
" " "	W. B. Richardson, Newton
" " "	S. J. Johnson, Ellisville
" " "	J. F. Story, Forest
" " "	Guarantee
SOUTHERN SOLUBLE	Lampton Mer. Co., Magnolia
" "	Guarantee
BLOOD BONE AND B	Ford Bros. Co., Centreville
" "	Guarantee
EARMERS' FRIEND	J. P. Meyer, Ellisville
"	Bonner Bros. Sandersville
" "	Guarantee
SOUTHERN ACID PHOSPHATE	W. M. McGough, Morton
" " "	W. B. Richardson, Newton
" " "	G. W. Walson, Hickory
" " "	D. O. Mathews, Iuka
" " "	Guarantee
Manufactured by **Standard Guano & Chemical Co.,** New Orleans, La.	
AMMONIATED R. B. SUPERPHOSPHATE	C. Atkinson, Summit
" "	Hyman Mer. Co., Summit
" "	Earns, Long & Co., Wesson
" "	Wm. Atkinson & Bacot Co., Osyka
" "	Guarantee
STANDARD AMMONIATED SOLUBLE GUANO	M. J. Have's Sons, Newton
" "	Guarantee

Laboratory Number	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value per Ton.
		Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
616	13.35	7.97	1.86	.85	10.68	2.04	1.84	$16.58
617	13.39	8.00	2.13	.68	10.81	1.97	1.87	16.72
622	13.01	7.85	2.20	.77	10.82	1.90	1.99	16.57
623	15.79	7.89	2.10	.88	10.87	1.94	1.89	16.52
624	13.71	8.02	1.86	.80	10.68	1.92	1.92	16.41
786	13.97	7.51	1.98	2.66	12.15	2.15	2.28	16.95
790	13.06	6.79	2.18	2.53	11.50	2.24	1.94	16.29
....	.....	*7.75*	*2.00*	*1.00*	*10.75*	*1.75*	*1.85*	*15.78*
701	15.09	7.93	2.01	1.18	11.12	2.12	1.73	16.77
..	.....	*7.75*	*2.00*	*1.00*	*10.75*	*1.75*	*1.85*	*15.78*
696	12.21	7.33	1.72	4.81	13.86	1.98	1.87	15.70
....	.....	*7.75*	*2.00*	*1.00*	*10.75*	*1.75*	*1.85*	*15.78*
698	15.90	9.61	1.97	.77	12.39	1.47	1.58	16.64
699	14.65	10.25	1.39	1.10	13.34	1.38	1.50	16.99
....	.....	*8.00*	*2.50*	*1.00*	*11.50*	*1.25*	*1.50*	*14.88*
673	15.42	12.74	2.31	1.18	16.23	.....	.....	13.32
674	16.29	14.17	1.04	1.05	16.26	.....	.....	13.58
675	16.34	13.92	1.50	.44	15.86	.....	.....	13.73
795	13.96	12.74	3.74	.45	16.93	.....	.....	14.46
....	.....	*12.50*	*2.00*	*.50*	*15.00*	.....	.....	*12.85*
632	12.74	7.42	1.94	1.80	11.16	1.73	1.64	15.13
633	13.78	7.46	2.29	1.15	10.90	1.76	1.45	15.37
634	13.25	7.27	3.07	.62	10.96	1.73	1.31	15.67
782	13.09	6.36	3.05	2.09	11.50	2.30	1.41	16.27
....	.....	*4.00*	*4.00*	*1.00*	*9.00*	*1.65*	*1.50*	*13.22*
785	12.32	6.00	2.64	2.96	11.60	1.96	1.46	14.74
....	.....	*4.00*	*4.00*	*1.00*	*9.00*	*1.65*	*1.50*	*13.22*

Name of Brand and Manufacturer.	Where and From Whom Collected.
MISSISSIPPI HOME GUANO	Dalrymple Johnson&Co., Amory
" " "	Guarantee
CHAMPION FARMER'S CHOICE	S. Wolf, Osyka
" "	Pfeifer & Dreyfus, Brookhaven
" "	Guarantee
BLOOD, BONE, AND MEAT GUANO	Hyman Mer. Co., Summit.
" " "	Guarantee
GROUND BONE	Lotterhos & Huber, Cryst'l Spr's
" "	S. Wolf, Osyka
" "	Hyman Mer. Co., Summit.
" "	Guarantee
ACID PHOSPHATE	Lampton Mer. Co., Magnolia
" "	J. P. Wise, Hazlehurst
" "	Seward & Faucher, McCool
" "	Guarantee
Manufactured by **Jackson Fertilizer Company,** Jackson, Miss.	
ROYAL C	Lotterhos & Huber, Cryst'l Spr's
"	C. Atkinson, Summit
"	Gallman Mer. Co., Gallman
"	Earns, Long & Co., Wesson
"	J. M. Stephenson, Morton
"	J. P. Myer, Ellisville
"	M. D. Graham & Co., Forest
"	Barney Johns & Co., Gloster
"	Guarantee
GULF STATES GUANO	T. C. Simmons & Co., Magnolia
" " "	Mayes & Berry, Hazlehurst
" " "	Guarantee
LOTTERHOS & HUBER'S TOMATO GROWER	Lotterhos & Huber, Cryst'l Spr's
" "	Guarantee

Laboratory Number.	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value Per Ton.
		Water Soluble	Citrate Soluble.	Insoluble.	Total.			
747	10 53	8.24	2.81	1.41	12.46	2.27	2.54	18.99
....	.....	*4.00*	*5.00*	*1.00*	*1.00*	*1.65*	*2.00*	*14.62*
706	10.78	6 84	2.28	1.46	10.58	2.16	1.81	16.10
707	11.65	6.56	2.63	.86	10.05	2.31	2 00	16.70
....	.....	*4.00*	*4.00*	*1.00*	*9.00*	*1.65*	*1.50*	*13.22*
700	11.58	8.25	2.05	1.38	11.68	1.90	2.89	17 74
....	.....	*4.00*	*4.25*	.....	.....	*1.70*	*2.00*	*14.07*
709	4.02	.....	.....	.....	22.16	3.77	....	20.50
710	4.52	.....	.....	.....	19.01	2.83	.....	16.58
767	4.70	.....	.....	.....	16,51	2.90	.....	15.51
....	.....	.....	.....	.....	*18.50*	*2.50*	.....	*15.50*
727	12.43	11.71	5.01	.92	17.64	.....	.....	14.55
728	13.81	10 85	5.51	1.87	18.23	.....	.....	14.17
791	11.85	10.40	6.29	1.80	18.49	.....	.....	14.39
....	.....	*10.00*	*2.00*	*1.00*	*13.00*	.....	.....	*10.60*
625	19.82	7.71	2.05	.93	10.69	1.82	1.76	15.27
626	17.66	8.05	2.02	.61	10.68	1.89	1.93	16.53
627	17.20	7.52	2.10	.81	10.43	1.99	1.90	16.29
628	19.99	7.51	2.09	.79	10.39	1,73	1.81	15.53
629	15.31	8.02	2.05	.84	10.91	1.81	1.95	16.35
744	17.96	7.87	2.13	1.05	11.05	1.95	1.79	16.45
784	20.20	7.82	1.84	.72	10.38	1.89	1.96	16.17
789	20.69	7.75	1.96	.73	10.44	1.84	1.75	15.86
....	.....	*6.00*	*1.60*	*1.00*	*8.60*	*1.55*	*1.80*	*13.12*
708	19.86	7.52	2.11	.90	10.53	1.80	1.82	15.74
783	18.98	7.94	1.98	.65	10.57	1.91	2.03	16.53
....	.....	*6.00*	*1.60*	*1.00*	*8.60*	*1.55*	*1.80*	*13.12*
768	12.21	8.05	2.78	.42	11.25	2.15	2.57	18.50
....	.....	*6.00*	*4.00*	*1.00*	*11.00*	*2.40*	*1.00*	*16.60*

Name of Brand and Manufacturer.	Where and From Whom Collected.
COMPLETE VEGETABLE AND FRUIT	Lotterhos & Huber, Cryst'l Spr's
" "	Gallman Mer. Co., Gallman
" "	Guarantee
ACID PHOSPHATE	W. H. Chambliss, Newton
" "	Guarantee
Manufactured by **Capital Fertilizer Company,** Jackson, Miss.	
NONPAREIL	Factory
"	Becker, Lyell & McGrath Co., Wesson
"	Lampton Mer. Co., Magnolia
"	M. J. L. Hoye's Sons, Newton
"	Walton, Gillaspy & Russell, Hickory
"	W. H. Barron & Co., Crystal Spr's
"	W. S. Howards & Co., Hazlehurst
"	J. L. Moyse & Bro., Summit
"	Guarantee
RED STAR	John Parker, Terry
" "	Wm. Atkinson & McDonald, Wes.
" "	Guarantee
MISSISSIPPI STATE GRANGE	T. M. Eagan, Crystal Springs
" "	Guarantee
VEGETABLE GROWER	W. S. Howard's & Co., Hazleh't
" "	Kemp & Abrams, Hazlehurst
" "	Guarantee
PRODUCER	T. C. Vivaret & Bro., Newton
"	Guarantee
KAINIT	Ford Bros. Co., Centreville
"	W. H. Barron & Co., Cryst'l Sp'gs
"	Guarantee
PURE BONE MEAL	Factory
" " "	Lampton Mer. Co., Magnolia
" " "	Hyman Mer. Co., Summit
" " "	Guarantee

Laboratory Number	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value per Ton.
		Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
630	7.61	5.10	1.58	1.20	7.88	3.31	5.76	20.56
631	7.45	5.01	2.55	.50	8.06	3.69	4.61	21.14
....	.....	*3.00*	*3.00*	*1.00*	*7.00*	*3.00*	*4.00*	*17.20*
677	13.05	13.32	3.65	1.11	18.08	.....	.....	14.91
....	.....	*12.50*	*2.00*	*1.00*	*15.50*	.....	.....	*12.85*
615	11.46	8.41	2.26	.72	11.39	1.73	2.20	16.97
618	11.87	7.79	2.31	.62	10.72	1.56	2.03	15.80
619	11.50	8.27	1.94	.74	10.95	1.88	2.10	16.82
620	11.21	5.06	4.98	.50	10.54	1.47	2.50	15.52
621	12.35	8.31	2.05	.71	11.07	1.64	2.08	16.34
743	11.35	8.19	2.44	.59	11.22	1.59	2.60	16.96
788	12.22	6.56	2.97	.78	10.31	1.76	1.98	15.61
765	11.86	7.48	3.04	1.20	11.72	1.70	2.73	17.21
....	.....	*6.00*	*1.00*	*.50*	*7.50*	*1.50*	*1.75*	*12.40*
705	10.42	6.83	3.23	.64	10.70	1.67	2.26	16.18
711	11.02	8.00	1.78	1.29	11.07	1.69	1.97	15.80
....	.....	*6.00*	*1.00*	*.50*	*7.50*	*1.50*	*1.75*	*12.40*
715	12.62	7.15	2.95	.81	10.91	1.91	2.07	16.65
....	.....	*6.00*	*1.00*	*.50*	*7.50*	*1.50*	*1.75*	*12.40*
712	9.50	5.85	2.35	.78	8.98	2.54	5.93	20.27
713	9.12	5.78	2.33	.63	8.74	2.85	5.86	20.86
....	.....	*5.00*	*2.00*	*.50*	*7.50*	*2.50*	*3.00*	*16.65*
714	11.66	7.36	1.55	.90	9.81	1.68	2.44	15.40
....	.....	*6.00*	*2.00*	*.50*	*8.50*	*1.50*	*1.75*	*13.30*
716	4.79	.....	.....	.....	.....	.....	12.18	12.18
717	6.93	.....	.....	.....	.....	.....	12.08	12.08
....	.....	.....	.....	.....	.....	.....	*12.00*	*12.00*
638	4.46	.....	.....	.....	27.70	2.28	.....	22.32
637	5.60	.....	.....	.....	27.26	2.27	.....	22.08
766	4.94	.....	.....	.....	24.85	3.80	.....	24.41
....	.....	.....	.....	.....	*25.00*	*2.25*	.....	*20.63*

Name of Brand and Manufacturer.	Where and From Whom Collected.
ACID PHOSPHATE.....	I. M. Eagan, Crystal Springs.
" "	Walton, Gillaspy & Russell, Hickory .....
" "	Ford Bros. Co., Centreville....
" "	Guarantee .....
Manufactured by **Mobile Phosphate and Chemical Co.** Mobile, Ala.	
MOBILE STANDARD.....	W. M. Hyde, Vossburg.....
" "	W. H. Chambliss, Newton .....
" "	Winner & Meyer, Meridian .
"	S. M. Barnett, Booneville.....
" "	W. H. Chambliss, Newton . ...
" "	Guarantee .....
K. K. K. AMMONIATED BONE	Hawkins & Co., Hattiesburg
" " "	J. L. Moyse & Bro., Summit..
" "	J. L. Moyse & Bro., Summit...
" "	Guarantee .....
ECLIPSE SOLUBLE GUANO	M. J. L. Hoye's Sons, Newton
" " "	Guarantee .....
I. X. L. ACID PHOSPHATE	Wm. Atkinson & McDonald, Wes
" " "	T. C. Simmons & Co., Magnolia
" " "	Guarantee .....
Manufactured by **Armour Packing Company,** Kansas City, Mo.	
FERTILIZER NO. 271....	W. L. Wellman, Wesson... ...
" "	Guarantee .....
FERTILIZER NO. 386....	Lotterhos & Huber, Cryst'l Spr's
" "	Guarantee .....
FERTILIZER NO. 272	Lann & Carter Hdw. Co., Aber'n
" "	Guarantee .....
Sold by **Marbach & Eagan,** Crystal Springs, Miss.	
BAT GUANO.....	Robinson Mer. Co., Centreville
" "	W. J. Davis, Terry.....
" "	Guarantee .....

Laboratory Number	Moisture Per Cent	Phosphoric Acid—Per Cent.				Nitrogen Per Cent.	Potash Per Cent.	Relative Value per Ton.
		Water Soluble.	Citrate Soluble	Insoluble	Total.			
639	12.11	12.51	3.83	.88	17.22	....	....	14.35
670	11.65	10.12	4.92	1.06	16.10	.....	.....	13.05
702	11.23	11.73	3.36	1.10	16.19	....	....	13.25
....	.....	*10.00*	*2.00*	.....	.....	....	.....	*10.00*
692	10.97	7.07	2.32	1.40	10.99	2.08	2.34	16.87
723	10.51	6.06	2.56	1.54	10.16	2.11	2.21	15.86
635	12.86	7.80	1.30	.98	10.08	2.03	2.39	16.44
748	10.24	7.68	1.65	1.38	10.99	2.29	2.53	17.07
781	11.74	6.41	2.78	2.39	11.60	1.81	2.41	15.87
..	....	*6.00*	*2.00*	*1.50*	*9.50*	*1.65*	*2.00*	*13.30*
690	12.94	8.15	1.72	.95	10.82	1.39	1.54	14.72
691	12.85	7.77	2.24	1.05	10.86	1.50	1.60	14.67
761	13.54	6.93	4.10	2.43	13.48	1.38	1.38	15.47
..	..	*8.75*	*1.25*	*1.50*	*11.50*	*.85*	*1.00*	*13.01*
726	13.21	8.19	2.02	1.16	11.37	2.01	2.32	17.36
....	....	*8.00*	*1.25*	*1.50*	*10.75*	*1.45*	*1.50*	*14.25*
724	12.76	10.91	2.80	1.73	15.44	....	....	12.06
725	12.75	10.55	3.57	2.57	16.49	....	....	12.20
...	...	*10.50*	*2.00*	*1.50*	*14.50*	.....	....	*10.60*
693	2.89	4.44	2.84	.70	7.98	1.42	1.11	$11.66
..	.....	*5.00*	*2.00*	*1.50*	*8.50*	*1.50*	*1.00*	*11.55*
694	4.45	5.16	3.08	1.47	9.71	2.41	6.34	20.29
.	.....	*5.00*	*3.00*	*2.00*	*10.00*	*2.50*	*6.00*	*19.95*
760	4.98	5.04	2.51	.51	8.06	1.71	2.27	13.84
.....	.....	*5.00*	*2.00*	*1.50*	*8.50*	*1.50*	*2.00*	*12.55*
718	18.80	.....	.....	.....	11.49	4.52	.69	18.38
719	20.08	.....	.....	.....	9.93	4.81	.63	18.62
....	.....	.....	.....	.....	*5.00*	*4.50*	*.75*	*15.00*

Name of Brand and Manufacturer.	Where and From Whom Collected.
Manufactured by **Planters' Fertilizer Company,** New Orleans, La.	
COTTON AND CORN FER.	Boyd & Lee, Wesson .... Guarantee .....
Manufactured by **Threefoot Bros. & Co.,** Meridian, Miss.	
THREEFOOT'S IMPROVED MIXTURE	J. L. Wells, Hickory .... Guarantee .....
HIGH GRADE ENGLISH ACID PHOSPHATE	J. L. Wells, Hickory Guarantee .....
Manufactured by **New Orleans Acid and Fertilizer Co.,** New Orleans, La.	
GOLDSMITH'S IMPROVED MIXTURE	L. Cohn & Bro., Brookhaven A. B. Wolf, Forest N. Doolittle, Newton G. W. Walton, Hickory Guarantee
GOLD DUST FOR COTTON AND CORN	Robinson Mer. Co., Centreville Guarantee .....
BLACK DIAMOND ACID PHOSPHATE	W. B. Potts Co., Kosciusko Guarantee .....
CRESCENT CITY ACID PHOSPHATE	N. Doolittle, Newton ..... Guarantee .....
Manufactured by **Tennessee Chemical Company,** Nashville, Tenn.	
OX BRAND BONE WITH AMMONIA AND POTASH	Mccrs & Egger, Columbus Guarantee .....

Laboratory Number.	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen Per Cent.	Potash—Per Cent.	Relative Value Per Ton.
		Water Soluble	Citrate Soluble.	Insoluble	Total.			
720	11.82	6.67	1.51	.06	8.24	2.22	1.65	15.23
....	.....	*7.00*	*1.50*	*.15*	*8.65*	*2.00*	*2.00*	*15.45*
722	10.82	8.19	2.73	.74	11.66	2.03	2.16	17.88
....	.....	*8.00*	*2.00*	.....	.....	*1.77*	*1.90*	*16.13*
721	15.04	11.51	4.08	.73	16.32	....	.....	13.62
....	.....	*12.50*	*2.50*	.....	.....	.....	.....	*13.25*
787	12.12	7.94	3.71	1.32	12.97	1.84	1.52	17.40
772	12.82	8.57	2.14	2.07	12.78	1.60	1.43	15.93
773	11.37	8.11	2.83	1.47	12.41	1.94	1.53	17.04
774	12.87	8.42	2.08	2.00	12.50	1.71	1.57	16.14
....	.....	*7.25*	*2.10*	*1.50*	*10.85*	*1.92*	*1.00*	*14.94*
778	10.36	8.52	2.48	1.93	12.93	1.59	1.34	16.07
....	.....	*7.25*	*2.10*	*1.50*	*10.85*	*1.92*	*1.00*	*14.94*
792	11.81	9.49	4.56	1.00	15.05	.....	.....	12.19
....	.....	*10.00*	*2.00*	*1.00*	*14.00*	.....	.....	*10.60*
794	12.16	8.37	5.64	.96	14.97	.....	.....	12.05
....	.....	*10.00*	*2.00*	*2.00*	*14.00*	.....	.....	*10.60*
757	10.28	8.46	3.54	1.60	13.60	1.13	1.34	15.81
....	.....	*8.00*	*2.00*	*1.00*	*11.00*	*.82*	*1.00*	*12.82*

TABLE 1.—Analyses of Commercial Fertilizers

Name of Brand and Manufacturer.	Where and From Whom Collected
OX BRAND COTTON GUANO	T. J. Bostic & Sons, Meridian
" "	Myers & Egger, Columbus
" "	Guarantee
OX B'D DISSOLVED BONE	Myers & Egger, Columbus
" " "	Guarantee
Manufactured by **Birmingham Fertilizer Co.,** Birmingham, Ala.	
BIRMINGHAM HIGH GR'D B. B. AND POTASH	Gilmore & May, Amory
" "	Guarantee
BOSS GUANO	Threefoot Bros. & Co., Meridian
" "	Guarantee
Manufactured by **Southern Fertilizer Company,** Atlanta, Ga.	
SCOTT'S ACID AND MEAL FORMULA	D. D. Richardson, Columbus
" "	Guarantee
SCOTT'S ACID PHOS.	D. D. Richardson, Columbus
" "	Guarantee
Manufactured by **Pacific Guano Co.,** Charleston, S. C.	
SOL. PACIFIC GUANO	Gilmore & May, Amory
" "	Guarantee
Manufactured by **P. B. Mathiason Manufacturing Co.,** St. Louis, Mo.	
VEGETABLE FERTILIZER.	J. B. Yellowley, Ridgeland
" "	Guarantee

Laboratory Number.	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value Per Ton.
		Water Soluble	Citrate Soluble.	Insoluble.	Total.			
776	9.53	7.84	3.28	1.55	12.67	1.64	1.19	16.02
759	9.36	8.06	5.57	.37	14.00	1.57	1.13	18.13
....	.....	*8.00*	*2.00*	*1.00*	*11.00*	*1.65*	*1.00*	*14.93*
758	11.12	11.07	3.14	1.13	15.34	.....	.....	12.48
....	.....	*11.00*	*3.00*	*1.00*	*15.00*	.....	.....	*12.30*
745	14.87	8.81	2.25	1.77	12.83	1.73	2.17	17.33
....	.....	*7.00*	*2.00*	*2.00*	*11.00*	*1.64*	*2.00*	*14.90*
775	11.69	9.56	1.36	.77	11.63	1.99	2.71	18.42
....	.....	*7.00*	*2.00*	*2.00*	*11.00*	*1.64*	*2.00*	*14.90*
756	11.06	8.21	3.77	3.44	15.42	1.32	1.22	16.12
....	.....	*7.00*	*3.00*	*1.00*	*11.00*	*.83*	*1.00*	*12.78*
749	11.01	9.98	5.10	3.72	18.80	.....	.....	13.06
....	.....	*11.00*	*3.00*	*1.00*	*15.00*	.....	.....	*12.30*
746	16.62	7.77	96	2.07	10.80	1.94	1.21	14.69
....	.....	*6.50*	*2.00*	*2.00*	*10.50*	*1.75*	*1.00*	*13.68*
777	8.97	2.12	4.19	3.13	9.44	4.21	1.79	18.21
....	.....	*3.50*	*4.50*	*1.50*	*9.50*	*3.75*	*2.00*	*18.93*

TABLE II.—Brands of Fertilizers Registered for Sale in the State, with Guarantees for Season 1897 '98.

Name of Brand and Address of Manufacturer.	Phosphoric Acid—Per Cent.				Nitrogen—per Cent.	Potash—per Cent.	Relative Value per Ton.
	Water Soluble.	Citrate Soluble.	Insoluble.	Total			
Standard Guano & Chemical Manufacturing Co., New Orleans, La.							
Wolf's Ammoniated R. B. Superphosphate	4.00	4.00	1.00	9.00	1.65	1.50	$13 12
Stern's Ammoniated R. B. Superphosphate	4.00	4.00	1.00	9.00	1.65	1.50	13 12
Standard Ammoniated Soluble Guano	4.00	4.00	1.00	9.00	1.65	1.50	13 12
Champion Farmer's Choice	4.00	4.00	1.00	9.00	1.65	1.50	13 12
Mississippi Home Guano	4.00	5.00	1.00	10.00	1.65	2.00	14 62
Blood Bone and Meat Guano	4.00	4.25	.....	.....	1.70	2.00	14 07
I. C. Diamond Brand	4.00	4.00	1.00	9.00	1.65	1.50	13 12
Pelican Raw Bone Guano	4.00	4.00	1.00	9.00	1.65	1.50	13 12
Ground Bone	.....	.....	.....	18.50	2.50	.....	15 50
Acid Phosphate	10.00	2.00	1.00	13.00	.....	.....	10 40
Kainit	.....	.....	.....	.....	.....	12.00	12 00
Meridian Fertilizer Factory. Meridian, Miss.							
Standard Home Mixture Guano	7.75	2.00	1.00	10.75	1.75	1.85	15 78

Southern Soluble Guano	7.75	2.00	1.00	10.75	1.75	1.85	15 78
Blood Bone and B. Guano	7.75	2.00	1.00	10.75	1.75	1.85	15 78
Farmer's Friend Guano	8.00	2.50	1.00	11.50	1.25	1.50	14 88
High Grade Vegetable Grower	5.00	1.00	.50	6 50	2.50	6.00	18 15
Southern Acid Phosphate	12.50	2.00	.50	15.00	.....	.....	12 85
Kainit	.....	.....	.....	.....	.....	12.00	12 00
Bone and Potash	8.00	2.50	.....	.....	.....	3.00	13 25
Jackson Fertilizer Company, Jackson, Miss.							
Royal C. Brand	6.00	1.60	1.00	8.60	1.55	1.80	13 12
Gulf States Guano	6.00	1.60	1.00	8.60	1.55	1.80	13 12
Vegetable and Fruit	3.00	3.00	1.00	7.00	3.00	4.00	17 20
Lotterhos & Huber's Tormato Grower	6.00	4.00	1.00	11.00	2.40	1.00	16 60
Kainit	.....	.....	.....	.....	.....	10.00	10 00
Acid Phosphate	12.50	2.00	1.00	15.50	.....	.....	12 85
Capital Fertilizer Company, Jackson, Miss.							
Nonpareil	6.00	1.00	.50	7 50	1.50	1.75	12 40
Red Star	6.00	1.00	.50	7.50	1.50	1.75	12 40
Producer	6.00	2.00	.50	8.50	1.50	1.75	13 30
Mississippi State Grange	6.00	1.00	.50	7.50	1.50	1.75	12 40
Vegetable Grower	5.00	2.00	.50	7.50	2.50	3.00	16 05
Raw Bone Meal	.....	.....	.....	25.00	2 25	.....	20 63
Acid Phosphate	10.00	2.00	.....	.....	.....	.....	10 60
Kainit	.....	.....	.....	.....	.....	12.00	12 00
Mobile Phosphate & Chemical Manufacturing Co., Mobile, Ala.							
Mobile Standard	6.00	2.00	1.50	9 50	1.65	2.00	13 93

TABLE II.—Brands of Fertilizers Registered for Sale in the State, with Guarantees for Season 1897 '98.

Name of Brand and Address of Manufacturer.	Phosphoric Acid—Per Cent.				Nitrogen—per Cent.	Potash—per Cent.	Relative Value per Ton.
	Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
K. K. K. Ammoniated Bone	8.75	1.25	1.50	11.50	.85	1.00	13 01
Eclipse Soluble Guano	8.00	1.25	1.50	10.75	1.45	1.50	14 25
Kainit	.....	.....	.....	.....	.....	12.00	12 00
I. X. L. Acid Phosphate	10.00	2.00	1.50	13.50	.....	.....	10 60
Southern Fertilizer Company, Atlanta, Ga.							
Scott's Gossypium Phospho	6.00	3.00	1.00	10.00	2.05	2.00	15 83
Scott's Potasso Phospho	10.00	3.00	1.00	14.00	.....	2.00	14 70
Scott's Animal Ammoniated Guano	6.00	3.00	1.00	10.00	1.65	1.00	13 83
Scott's Acid and Meal Formula	7.00	3.00	1.00	11.00	.83	1.00	12 78
Scott's High Grade Acid Phosphate	11.00	3.00	1.00	15.00	.....	.....	12 30
Armour Packing Company, Kansas City, Mo.							
Blood Bone and Potash	6.00	3.00	2.00	11.00	4.50	7.00	26 95
Fertilizer No. 386	5.00	3.00	2.00	10.00	2.50	6.00	19 95
Fertilizer No. 271	5.00	2.00	1.50	8.50	1.50	1.00	11 55

Fertilizer No. 272	5.00	2.00	1.50	8.50	1.50	2.00	12 55
Fertilizer No. 281	5.50	2.50	1.50	9.50	1.50	1.00	12 55
Fine Ground Beef Bone		12.50	12.50	25.00	2.50		23 75
Cotton Grower	5.50	2.50	1.50	9.50	1.50		14 50
Planters' Fertilizer Company, New Orleans, La.							
Cotton and Corn Fertilizer	7.00	1.50	.15	8.65	2.00	2.00	15 35
Marbach & Eagan. Crystal Springs, Miss							
Bat Guano				5.00	1.50	.75	15 00
Tennessee Chemical Co., Nashville, Tenn							
Ox Brand High Grade Guano	8.00	2.00	1.00	11.00	2.00	1.25	16 05
Ox Brand Cotton Guano	8.00	2.00	1.00	11.00	1.65	1.00	14 93
Ox Brand Ammoniated Bone	8.00	2.00	1.00	11.00	1.65	2.00	15 93
Ox Brand Bone with Ammonia and Potash	8.00	2.00	1.00	11.00	.82	1.00	12 82
Ox Brand Bone and Potash	9.00	3.00	1.00	13.00		1.00	12 70
Ox Brand High Grade Dis. Bone	11.00	3.00	1.00	15.00			12 50
Goulding Fertilizer Company, Pensacola, Fla.							
Goulding's Bone Compound	8.00	2.00	2.00	12.00	1.65	1.50	15 43
Goulding's Acid Phosphate	12.00	2.00	1.00	16.00			13 50
New Orleans Acid and Fertilizer Co., New Orleans, La.							
Goldsmith's Improved Mixture	7.25	2.00	1.50	10.85	1.82	1.00	14 94
Gold Dust for Cotton and Corn	7.25	2.00	1.50	10.85	1.82	1.00	14 94
Horse Shoe Fertilizer	7.25	2.00	1.50	10.85	1.82	1.00	14 94
Black Diamond Acid Phosphate	10.00	2.00	2.00	14.00			10 60
Crescent City Acid Phosphate	10.00	2.00	2.00	14.00			10 60

TABLE II.—Brands of Fertilizers Registered for Sale in the State, with Guarantees for Season 1897 '98.

Name of Brand and Address of Manufacturer.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value Per Ton.
	Soluble.	Citrate Soluble.	Insoluble.	Total.			
Threefoot Bros. & Co., Meridian, Miss.							
Threefoot's Improved Mixture	8.00	2.00	.....	.....	1.77	1.90	$16 13
High Grade English Acid Phosphate	12.50	2.50	.....	.....	.....	.....	13 25
Pacific Guano Co., Charleston, S. C.							
Soluble Pacific Guano	6.50	2.00	2.00	10.50	1.75	1.00	13 68
Birmingham Fertil'r Co., Birmingham, Ala.							
Cahaba High Grade B. B. and Potash	7.00	2.00	2.00	11.00	1.64	2.00	14 90
Birmingham High Grade B. B. and Potash	7.00	2.00	2.00	11.00	1.64	2.00	14 90
Birmingham High Grade Fertilizer	7.00	2.00	2.00	11.00	1.64	2.00	14 90
Boss Guano	7.00	2.00	2.00	11.00	1.64	2.00	14 90
Birmingham High Grade Dissolved Bone	11.00	2.00	2.00	15.00	.....	.....	11 50
Birmingham High Grade Acid Phosphate	11.00	2.00	2.00	15.00	.....	.....	11 50
Prolific Acid Phosphate	11.00	2.00	2.00	15.00	.....	.....	11 50
A. D. Adair & McCarty Bros., Atlanta, Ga.							
Buffalo Bone Fertilizer	6.00	3.00	2.00	11.00	1.75	1.00	14 08
Furman's Soluble Bone	6.00	4.00	2.00	12.00	.85	1.00	12 73
Farish Furman Formula	6.00	4.00	2.00	12.00	.....	2.00	11 60
Furman High Grade Dissolved Bone	8.00	4.00	2.00	14.50	.....	.....	10 40

P. B. Mathiason M'f'g. Co., St. Louis, Mo.							
Vegetable Fertilizer	3.50	4.50	1.50	9.50	3.75	2.00	18 93
Two and Eight	4.00	4.00	....	.....	1.65	.....	11 73
Pure Bone Meal	.....	.....	.....	21.00	3.20	.....	18 50
Bradley Fertilizer Co., Charleston, S. C.							
Bradley's Palmetto Acid Phosphate	9.00	3.00	2.00	14.00	....	.....	10 50
B. D. Sea Fowl Guano	6.50	2.50	2.00	11.00	1.85	1.00	14 38
The Stono Phos. Works, Charleston, S. C.							
Stono X. Dissolved Bone	11.00	2.00	2.00	15.00	.....	.....	11 50
Capital City Oil Mill Co., Baton Rouge, La.							
Capital Fertilizer	6.50	1.50	1.00	9.00	2.00	1.70	14 55

ANALYSES and GUARANTEES

—OF—

FERTILIZERS

ON SALE IN MISSISSIPPI.

Third Monthly Edition, Season 1897-'98.

These bulletins will be sent free to any address upon application to State Chemist.

Mississippi Agricultural

EXPERIMENT STATION.

BULLETIN No. 48 MAY 1, 1898

Analyses of Commercial Fertilizers.

B. W. KILGORE, State Chemist.

The following analyses of fertilizers on sale in the State have been made since the third edition of the fertilizer bulletin (Special Bulletin No. 47) was issued on March 25, 1898. Another edition of the fertilizer bulletin will be published some time during the summer, to include all analyses made during the season.

Name of Brand and Manufacturer.	Where and From Whom Collected.
Manufactured by **Meridian Fertilizer Factory,** Meridian, Miss.	
STANDARD HOME MIXTURE	G. K. Evans & Co., Pachuta Guarantee
SOUTHERN SOLUBLE	T. B. Gaddis, Morton Guarantee
BLOOD BONE AND B	Seward & Gaston, Ackerman
" " "	C. P. McGee, Gloster
" " "	Bonner Bros., Sandersville
" " "	Weems & Floyd, Shubuta Guarantee
Manufactured by **Standard Guano & Chemical Co.,** New Orleans, La.	
Pelican Raw Bone Guano	Wm. Atkinson Bacot Co. Osyka Guarantee
STERN'S AMMONIATED B. B. SUPERPHOSPHATE	Daniel & Willoughby, Brookh'v'n Guarantee
CHAMPION FARMER'S CHOICE	Sandersville Mer. Co., Sandersville
" "	T. M. Heidelberg, Heidelberg Guarantee
MISSISSIPPI HOME GUANO	B. F. Fridge, Ellisville Guarantee
BLOOD, BONE, AND MEAT GUANO	Hyman Mer. Co., Summit.
" " "	J. L. Strahan, Poplarville Guarantee
Manufactured by **Jackson Fertilizer Company,** Jackson, Miss.	
ROYAL C	J. Q. Martin, Hazlehurst Guarantee
COMPLETE VEGETABLE AND FRUIT	Robinson Mer. Co., Centerville Guarantee

Laboratory Number.	Moisture—Per Cent	Phosphoric Acid—Per Cent				Nitrogen Per Cent	Potash Per Cent	Relative Value Per Ton
		Water Soluble	Citrate Soluble	Insoluble	Total			
825	13.01	7.97	2.49	1.89	12.35	2.28	1.85	$17.74
....	.....	*7.75*	*2.00*	*1.00*	*10.75*	*1.75*	*1.85*	*15.78*
804	14.02	7.64	1.77	2.07	11.48	2.01	1.79	16.05
....	.....	*7.75*	*2.00*	*1.00*	*10.75*	*1.75*	*1.85*	*15.78*
802	14.34	6.86	2.69	4.54	14.09	1.75	1.58	15.24
803	13.51	6.84	2.15	4.18	13.17	2.19	2.59	16.82
843	13.80	6.75	2.30	4.04	13.09	2.10	2.45	16.52
844	16.49	8.26	2.31	2.32	12.91	1.76	2.25	16.99
....	.....	*7.75*	*2.00*	*1.00*	*10.75*	*1.75*	*1.85*	*15.78*
814	12.28	6.01	3.49	2.06	11.56	1.99	1.20	15.33
....	.....	*4.00*	*4.00*	*1.00*	*9.00*	*1.65*	*1.50*	*13.22*
816	12.48	6.73	3.12	1.88	11.73	2.17	1.34	16.30
....	.....	*4.00*	*4.00*	*1.00*	*9.00*	*1.65*	*1.50*	*13.22*
845	11.27	7.24	1.86	2.16	11.26	1.97	1.55	15.39
846	11.57	7.38	1.95	2.00	11.33	1.71	1.66	15.08
....	.....	*4.00*	*4.00*	*1.00*	*9.00*	*1.65*	*1.50*	*13.22*
831	12.21	8.57	2.73	2.61	13.91	2.12	2.59	18.92
....	.....	*4.00*	*5.00*	*1.00*	*10.00*	*1.65*	*2.00*	*14.62*
813	11.27	8.35	2.54	1.89	12.78	2.24	2.46	18.70
832	11.00	6.54	3.41	1.83	11.78	2.48	2.70	18.51
....	.....	*4.00*	*4.25*	.....	.....	*1.70*	*2.00*	*14.07*
834	20.05	7.70	2.07	.67	10.44	1.79	1.85	15.89
....	.....	*6.00*	*1.60*	*1.00*	*8.60*	*1.55*	*1.89*	*13.12*
809	18.58	4.03	2.87	.40	7.30	3.12	3.95	18.41
.. ..	.....	*3.00*	*3.00*	*1.00*	*7.00*	*3.00*	*4.00*	*17.20*

Name of Brand and Manufacturer.	Where and From Whom Collected.
Manufactured by **Capital Fertilizer Company,** Jackson, Miss.	
RED STAR	Carr & Carr, McCool
	Guarantee
MISSISSIPPI STATE GRANGE	Moore Bros., Morton
	Guarantee
ACID PHOSPHATE	M. J. L. Hoye's Son., Newton..
" "	Carr & Carr, McCool
	Guarantee
Manufactured by **Mobile Phosphate and Chemical Co.** Mobile, Ala.	
MOBILE STANDARD	J. E. Buckley, Enterprise
	Guarantee
ECLIPSE SOLUBLE GU'NO	J. W. McKay, Waynesboro
" " "	J. M. Stevenson, Morton
	Guarantee
	Lann & Carter Hdw. Co., Aberdeen
I. X. L. ACID PHOSPHATE	
" " "	W. B. Potts Co., Kosciusko
	Guarantee
Manufactured by **Armour Packing Company,** Kansas City, Mo.	
FERTILIZER NO. 271	W. L. Wellman, Wesson
	Guarantee
FERTILIZER NO. 272	M. E. Gilbert, Meridian
	Guarantee
COTTON GROWER	M. E. Gilbert, Meridian
	Guarantee
B. B. AND POTASH	M. E. Gilbert, Meridian
	Guarantee
Sold by **Marbach & Eagan,** Crystal Springs, Miss.	
BAT GUANO	J. P. Wise, Hazlehurst
	Guarantee

Laboratory Number	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value per Ton.
		Water Soluble	Citrate Soluble	Insoluble	Total.			
806	10.86	7.77	2.63	1.27	11.67	1.60	2.57	16.71
		8.00	*1.00*	*.50*	*7.50*	*1.50*	*1.75*	*12.40*
817	12.00	7.07	3.77	1.46	12.30	1.64	2.10	16.66
		6.00	*1.00*	*.50*	*7.50*	*1.50*	*1.75*	*12.40*
839	11.89	11.59	3.65	.43	15.67			13.35
840	11.69	11.63	3.42	.81	15.26			12.66
		10.00	*2.00*					*10.60*
829	12.71	7.47	2.13	1.60	11.20	1.82	2.49	16.43
		6.00	*2.00*	*1.50*	*9.50*	*1.65*	*2.00*	*13.93*
812	12.44	8.78	1.41	1.94	12.13	2.09	2.49	17.77
838	12.38	6.54	2.65	1.61	10.80	2.21	2.78	17.23
		8.00	*1.25*	*1.50*	*10.75*	*1.45*	*1.50*	*14.25*
800	13.92	10.98	2.98	2.60	16.56			12.27
801	14.17	9.85	3.23	3.40	16.48			11.45
		10.00	*2.00*	*1.50*	*13.50*			*10.60*
815	3.14	4.39	2.53	.58	7.50	1.29	1.20	11.09
		5.00	*2.00*	*1.50*	*8.50*	*1.50*	*1.00*	*11.55*
819	3.52	4.75	2.43	.78	7.96	1.47	2.39	13.00
		5.00	*2.00*	*1.50*	*8.50*	*1.50*	*2.00*	*12.55*
820	3.31	5.36	2.88	.45	8.69	1.52		11.75
		5.50	*2.50*	*1.50*	*9.50*	*1.50*		*11.50*
827	5.37	4.77	5.36	1.37	11.50	4.83	6.36	28.02
		6.00	*3.00*	*2.00*	*11.00*	*4.50*	*7.00*	*26.95*
811	19.34				11.80	4.26	.75	18.48
					5.00	*4.50*	*.75*	*15.00*

Name of Brand and Manufacturer.	Where and From Whom Collected
Manufactured by **Threefoot Bros. & Co.,** Meridian, Miss.	
THREEFOOT'S IMPROVED MIXTURE	Threefoot Bros. & Co., Meridian Guarantee
HIGH GRADE ENGLISH ACID PHOSPHATE	Threefoot Bros. & Co., Meridian Guarantee
Manufactured by **New Orleans Acid and Fertilizer Co.,** New Orleans, La.	
GOLD DUST FOR COTTON AND CORN	J. K. Kirkland, Quitman
" " " "	Wm. Atkinson-Bacot Co., Osyka
" " " "	Hattiesburg Compress Co., Hattiesburg
	Guarantee
BLACK DIAMOND ACID PHOSPHATE	Hattiesburg Compress Co., Hattiesburg
	Guarantee
CRESCENT CITY ACID PHOSPHATE	J. P. & W. C. Wetherbee, Waynesboro
Manufactured by **Tennessee Chemical Company,** Nashville, Tenn.	Guarantee
OX BRAND HIGH GRADE DIS. BONE	T. J. Bostic & Son, Meridian
	Guarantee
Goulding Fertilizer Company, Pensacola, Fla.	
GOULDING'S ACID PHOSPHATE	Hawkins & Co., Hattiesburg
	Guarantee
Manufactured by **Planters' Fertilizer Company,** New Orleans, La.	
COTTON AND CORN FER	Boyd & Lee, Wesson
	Guarantee

Laboratory Number.	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Val. Per Ton.
		Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
805	13.52	7.11	2.00	2.25	11.36	2.31	2.77	17.45
		8.02	*2.00*			*1.77*	*1.90*	*16.13*
841	14.98	12.09	4.54	1.01	17.64			14.51
		12.50	*2.50*					*13.25*
818	12.03	8.37	2.99	2.09	13.45	1.72	1.42	16.77
836	11.38	7.60	4.21	.92	12.73	2.03	1.52	17.98
837	12.97	7.60	3.58	1.42	12.60	1.67	1.70	16.70
		7.25	*2.10*	*1.50*	*10.85*	*1.92*	*1.60*	*14.94*
847	12.68	8.58	4.35	1.39	14.32			11.23
		10.00	*2.00*	*2.00*	*14.00*			*10.60*
808	11.28	7.60	6.14	1.22	14.96			11.75
		10.00	*2.00*	*2.00*	*14.00*			*10.60*
807	12.12	13.65	2.65	.77	17.07			14.41
		11.00	*3.00*	*1.00*	*15.00*			*12.50*
830	7.75	12.88	3.87	4.31	21.06			14.69
		13.00	*2.00*	*1.00*	*16.00*			*13.30*
810	11.66	6.75	1.56	.06	8.37	2.04	2.21	15.46
		7.00	*1.50*	*.15*	*8.65*	*2.00*	*2.00*	*15.35*

MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

Special Bulletin No. 49.

Alalyses of Commercial Fer=tilizers

ON SALE IN THE STATE.

SEASON 1897-'98.

Agricultural College, Miss., June 25, 1898.

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Mississippi Fertilizer Control.

INSPECTION AND ANALYSES OE FERTILIZERS

BY THE CHEMICAL DEPARTMENT OF THE

MISSISSIPPI AGRICULTURAL AND MECHANICAL COLLEGE.

B. W. KILGORE, State Chemist.
W. F. HAND, Assistant Chemist.
E. W. MAGRUDER, Ass't. Chemist.
J. S. CARROLL, Ass't. Chemist.

The analyses presented in this bulletin are of samples of fertilizers collected by the fertilizer inspector of this department. The analyses of samples sent to the department by manufacturers are not published because they do hot always represent the true character of the goods actually put on sale. The samples, the analyses of which are presented in this bulletin, were taken from December to June from goods in the hands of fertilizer dealers, and therefore represent the composition of the fertilizers the farmers actually bought and used.

This is the fifth fertilizer bulletin for this season, 1897 '98, four editions having been previously issued. These were gotten out January 7th, February 15th, March 25th, and May 1st. By these frequent and early

NOTE.—The analysis and inspection of commercial fertilizers is by law done by the Professor of Chemistry at the College, who is State Chemist. The results being considered of agricultural value are sent out by the Experiment Station. All communications in regard to these Bulletins or analyses should be addressed to State Chemist.

publications during the growing season farmers were enabled in many cases to know the composition and character of their fertilizers before they bought and used them. This edition of the bulletin is the last one for this season, and includes the analyses of all samples made during the season, both those published in previous bulletins and those made since the last bulletin was issued.

The fertilizer season just passed has been a successful and satisfactory one. The goods offered for sale and sold have been, as a rule, good, as will be seen by a comparison of the analyses in the bulletin with the guarantees made by manufacturers.

TERMS USED IN ANALYSES.

Nitrogen, Phosphoric Acid, and Potash are the three constituents in a fertilizer which give to it its value. They do not make up all of a fertilizer—in fact in most fertilizers other constituents are present in larger quantities than are these—but they are the only ones to which values need be assigned. The amounts of these constituents found in the fertilizers analyzed are expressed in the table as percentages or pounds in one hundred pounds of the fertilizer.

Four columns are given to phosphoric acid. In the first is found the water-soluble phosphoric acid, or the portion dissolved by cold water; in the second one is found the citrate-soluble, or the portion soluble in ammonium citrate solution; in the third the portion not soluble in either water or citrate solution, but soluble in strong acid; in the fourth column is given the total phosphoric acid, or the sum of the preceding forms. The water-soluble and citrate-soluble represent the phosphoric acid immediately available for plant growth.

Two sets of percentages are given in the table, "found" and "guaranteed." The percentages found represent the results actually obtained in the analysis of the fertilizers, while the guaranteed percentages are what the manufacturers claim them to contain.

VALUATIONS.

In order to have a basis of comparison for the different fertilizers, valuations are assigned to the three valuable ingredients—nitrogen, phosphoric acid, and potash. These valuations are not intended to represent *crop producing power or agricultural value*, but are *estimates of the commercial* value of nitrogen, phosphoric acid, and potash in the materials supplying them. While the valuations are only approximate, it is believed that they fairly represent the cost of making and putting the fertilizers on the market. They are based upon a careful examination of the trade conditions, wholesale and retail, and upon quotations from manufacturers.

The figures used in calculating the "relative value per ton" in this bulletin are practically the same as those used last season, and are as follows:

	per pound.
For Nitrogen	12.5 cents
For potash	5 cents
For water-soluble phosphoric acid in mixed fertilizers	5 cents
For water-soluble phosphoric acid in unmixed acid phosphates	4.5 cents
For citrate-soluble phosphoric acid in mixed fertilizers	4.5 cents
For citrate-soluble phosphoric acid in unmixed acid phosphates	4 cents
For phosphoric acid in fine ground bone	3 cents
For phosphoric acid in medium and coarse bone	2.5 cents

All relative values during this season will be calculated by the use of these figures.

HOW RELATIVE VALUES ARE CALCULATED.

It may not be clear to all how values per ton are calculated. To make this plain an example is given. It is to be remembered that the figures in the table represent

pounds and parts of a pound of nitrogen, phosphoric acid, and potash in one hundred pounds of the fertilizer, and that there are twenty hundred pounds in one ton (2,000 pounds.)

The calculation is made as follows:

Percentage or lbs. in 100.	Val. per 100 lbs.	Val. per ton (2,000 lbs.)
6 lbs. Water-sol. phos. acid at 5c per lb.	$0.30 x 20 =	$ 6 00
2 lbs. Citrate-sol. phos. acid at 4½c. per lb	0.09 x 20 =	1 80
2 lbs. Nitrogen at 12½ cents per pound...	0.25 x 20 =	5 00
2 lbs. Potash at 5 cents per pound.....	0.10 x 20 =	2 00
Total value.....	$0.74 x 20 =	$ 14.80

DATA IN THE TABLES.

The data in the table will be readily understood. In it will be found the analyses of samples collected this season. Several analyses are given of most of the brands, together with the dealers selling them, and under the analyses will be found the average of all analyses made, and the guarantees made by the manufacturer. A comparison of the analyses and average analysis with guarantee will show how well the goods sold agree with the claims made for them.

FERTILIZER LAW.

The fertilizer law is published here for the information of those who may not be familiar with it and is taken from Chapter 48, Annotated Code 1892, with amendments, 1896:

FERTILIZERS.

Definition of Term as Used: The term fertilizer, as used herein, includes all substances, chemicals and compounds, commonly known as commercial fertilizers, and all manures, except animal excrement, cotton seed and unmixed cotton-seed products and castor pomace, whether natural or artificial products.

To be Analyzed by State Chemist---His Certificate: The Professor of Chemistry, at the Agricultural and Mechanical College, is State Chemist; and all fertilizers shall be analyzed by him, and his certificate of anaylsis, stating the percentage therein of nitrogen, in an available form, of potash soluble in water, and of phosphoric acid in an available form, soluble or reverted, and of insoluble phosphoric acid, shall be posted and kept posted, in a conspicuous manner, at every place where the same are sold.

Certificate by Manufacturer: There shall also be so posted the certificate of the manufacturer or producer of every brand of fertilizer, giving the component parts thereof, and the valuable elements, as prescribed for the State Chemist's certificate, and guaranteeing that it does not contain leather in any form, and giving the place of manufatcture or production, the name and address of the manufacturer or producer, and the name of the trade-mark of the brand, and such certificate, and the prescribed tag, shall be pasted on, or attached to, every package of fertilizer sold.

Chemist to Analyze Samples and to Furnish Certificates and Tags: Before offering any fertilizer for sale, the manufacturer, producer, or seller, shall furnish to the State Chemist, a certificate of the manufacturer or producer, showing the component parts thereof, and a fair sample of it, not less than one pound, sealed up in a glass jar; and the Chemist shall analyze it and give his certificate thereof, and shall furnish the necessary number of tags; he shall also, from time to time, secure samples from packages offered for sale, or sold; analyze the same and record the analyses.

Chemist to Analyze Samples sent by Farmers or other Purchasers: The State Chemist shall also analyze all fair samples of fertilizers properly certified and prepared which may be furnished to him by farmers and other purchasers for use free of charge, and shall give a certificate thereof.

Certificate of Chemist as Evidence: The certificate of analysis of the State Chemist shall be evidence of the

percentage of the valuable elements in any fertilizer analyzed by him.

Tags, How Supplied: Forgery to Counterfit or Use a Second Time: The State Chemist shall have prepared a sufficient number of tags of suitable material and form, with proper fastenings for attaching to packages, and having printed thereon the word "Guranteed," with the year of sale, number of the tag, and a *fac simile* of his signature. Any person who shall counterfeit a fertilizer tag, or who shall use one not sold to him by the State Chemist, or who shall use one a second time, shall be guilty of forgery.

Fees for Analysis and for Tag: The State Chemist shall charge and collect for the analysis of each brand of fertilizer the sum of fifteen dollars, and for enough tags for one ton of fertilizer, thirty cents.

Fees, how Used and Accounted for: The fees received by the State Chemist shall be deposited with the Treasurer of the Agricultural and Mechanical College, and shall be expended, under the directions of the Board of Trustees, in defraying the expenses of analyzing fertilizers, the preparation of tags, and otherwise, as the board shall allow or direct.

Certificate good for one Season only: The certificate of the State Chemist shall be good for one year, if no fraud or deception be practiced in obtaining it, and an analysis must be made every year or season, of each brand of fertilizer.

Record of Analysis, and of Tags Issued, to be Kept: The State Chemist shall record, in a suitable book, the result of every analysis of fertilizer made by him, specifically showing the percentage of valuable elements, the date of the analysis, the name and residence of the manufacturer or producer, the name of the brand and place of manufacture or production, and the number of tags issued for each brand.

Kind of Package Fertilizer Sold in: Every fertilizer shall be sold and delivered in a barrel. box, sack or other

package, convenient for handling, and suitable for having attached thereto the ceitificate and tag,

Manufacturer, Owner and Agent Liable for Damages: Every manufacturer, owner or agent; selling any spurious or adulterated fertilizer, or any fertilizer which shall lack materially in a valuable element represented to be therein, shall be liable to the person injured for quadruple the price received, or agreed upon for the article sold.

Adulterated Fertilizer Forfeited and Contracts Avoided: If any fertilizer shall be sold, offered or kept for sale, which is spurious or adulterated or which has not been analyzed by the State Chemist and tagged, or which shall lack materially any of the valuable elements specified in the certificate of analysis, the whole of that shipment of fertilizer shall be forfeited to the county wherein the same may be, and that, whether the fraud be perpetrated by the manufacturer or owner, or by an agent or servant or other person having control of it; and all contracts made for the sale of it, shall be void, *ab initio*, wherever stipulated to be performed.

Whenever the State Chemist or any other citizen shall make affidavit before any competent officer, that untagged or other fraudulent fertilizer is being sold, in violation of the provisions of this act, the officer shall issue a writ of attachment, in the name of the State of Mississippi, returnable to the court having jurisdiction of the amount in controversy; and by virtue of said writ the sheriff or other competent officer shall seize the fertilizer mentioned and hold the same subject to the action of the court. The defendants shall be summoned to answer said attachment as defendants are required to be summond under the general attachment laws of this State. And upon the order of the court the fraudulent, or untagged, or adulterated fertilizer becomes the property of the county wherein the same may be.

Laboratory No.	Name of Brand and Manufacturer.	Where and From Whom Collected.
	Armour Packing Company, Kansas City, Mo.	
827	B. B. AND POTASH.....	M. E. Gilbert, Meridian.....
		Guarantee .....
820	COTTON GROWER.....	M. E. Gilbert, Meridian.....
		Guarantee .....
815	FERTILIZER NO. 271....	W. L. Wellman, Wesson.....
693	" "	W. L. Wellman, Wesson.....
		Average .....
		Guarantee .....
760	FERTILIZER NO. 272.....	Lann & Carter Hdw. Co., Aber'n
819	" "	M. E. Gilbert, Meridian.....
		Average .....
		Guarantee .....
694	FERTILIZER NO. 386.....	Lotterhos&Huber, Cryst'l Spr's
		Guarantee .....
	Birmingham Fertilizer Company, Birmingham, Ala.	
	BIRMINGHAM HIGH GR'D	
745	B. B. AND POTASH....	Gilmore & May, Amory.....
		Guarantee .....
775	BOSS GUANO.....	Threefoot Bros.&Co., Meridian.
		Guarantee .....
	Bradley Fertiiizer Company, Charleston, S. C.	
	BRADLEY'S PALMETTO	
881	ACID PHOSPHATE.....	Henry Key, Lauderdale.....
882	" "	C. W. Cochran, Lizelia.....
		Average .....
		Guarantee .....
	Capital Fertilizer Company, Jackson, Miss.	
639	ACID PHOSPHATE	I. M. Eagan, Crystal Springs..
676	" "	Walton, Gillaspy&Russell, Hicky
793	" "	Ford Bros Co., Centreville.....

Laboratory Number	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value per Ton.
		Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
827	5.37	4.77	5.36	1.37	11.50	4.83	6.36	28.03
....	.....	*6.00*	*3.00*	*2.00*	*11.00*	*4.50*	*7.00*	*26.95*
820	3.31	5.36	2.88	.45	8.69	1.52	.....	11.75
....	.....	*5.50*	*2.50*	*1.50*	*9.50*	*1.50*	.....	*11.50*
815	3.14	4.39	2.53	.58	7.50	1.29	1.20	11.09
693	2.89	4.44	2.84	.70	7.98	1.42	1.11	11.66
....	3.01	4.42	2.68	.64	7.74	1.36	1.16	11.39
....	.....	*5.00*	*2.00*	*1.50*	*8.50*	*1.50*	*1.00*	*11.55*
760	4.98	5.04	2.51	.51	8.06	1.71	2.27	13.84
819	3.52	4.75	2.43	.78	7.96	1.47	2.39	13.00
....	4.25	4.89	2.74	.64	8.01	1.59	2.32	13.42
....	.....	*5.00*	*2.00*	*1.50*	*8.50*	*1.50*	*2.00*	*12.55*
694	4.45	5.16	3.08	1.47	9.71	2.41	6.34	20.29
....	.....	*5.00*	*3.00*	*2.00*	*10.00*	*2.50*	*6.00*	*19.95*
745	14.87	8.81	2.25	1.77	12.83	1.73	2.17	17.33
....	.....	*7.00*	*2.00*	*2.00*	*11.00*	*1.64*	*2.00*	*14.90*
775	11.69	9.56	1.30	.77	11.63	1.99	2.71	18.42
....	.....	*7.00*	*2.00*	*2.00*	*11.00*	*1.64*	*2.00*	*14.90*
	12.12	9.66	3.37	1.19	14.22	.....	.....	11.39
881	12.01	9.66	3.29	1.25	14.20	.....	.....	11.33
882	12.06	9.66	3.33	1.22	14.21	.....	.....	11.36
....	.....	*9.00*	*3.00*	*2.00*	*14.00*	.....	.....	*10.50*
....								
639	12.11	12.51	3.83	.88	17.22	.....	.....	14.33
676	11.65	10.12	4.92	1.06	16.10	.....	.....	13.05
793	11.23	11.73	3.36	1.10	16.19	.....	.....	13.25

Laboratory No.	Name of Brand and Manufacturer.	Where and From Whom Collected.
839	ACID PHOSPHATE (con'd)	M. J. L. Hoye's Son, Newton....
840	" "	Carr & Carr, McCool.....
871	" "	A. E. Kelly, Kosciusko.....
		Average .....
		Guarantee .....
716	KAINIT.....	Ford Bros. Co., Centreville....
717	"	W. H. Barron&Co., Cryst'l Sp'gs
		Average .....
		Guarantee .....
715	MISSISSIPPI STATE	I. M. Eagan, Crystal Springs..
817	GRANGE	Moore Bros., Morton.....
863	" "	J. T. Lilly, Summit.....
		Average .....
		Guarantee .....
615	NONPAREIL	Factory.....
	"	Becker, Lyell & McGrath Co.,
618		Wesson.....
619	"	Lampton Merc. Co., Magnolia.
620	"	M. J. L. Hoye's Sons, Newton..
	"	Walton, Gillaspy & Russell,
621		Hickory .....
743	"	W. H. Barron&Co., Crystal Spr's
788	"	W. S. Howards & Co., Hazlehurst
765	"	J. L. Moyse & Bro., Summit...
		Average .....
		Guarantee .....
714	PRODUCER.....	T. C. Vivaret & Bro., Newton..
870	"	J. H. Eddleman, Wier's .....
		Average .....
		Guarantee .....
638	PURE BONE MEAL	Factory.....
637	" " "	Lampton Mer. Co., Magnolia..
766	" " "	Hymon Mer. Co., Summit.....
		Average .....
		Guarantee .....
705	RED STAR.....	John Parker, Terry.....
711	" "	Wm. Atkinson&McDonald, Wes'n

Laboratory Number.	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Val. Per Ton.
		Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
839	11.89	11 59	3.65	.43	15.67	.....	.....	13.35
840	11.69	11.03	3.42	.81	15.26	.....	.....	12.66
871	7.93	13.07	1.10	.88	15.05	.....	.....	12.64
....	11.08	11.67	3.38	.86	15.92	.....	.....	13.21
....	.....	*10.00*	*2.00*	.....	.....	.....	.....	*10.60*
716	4.79	.....	.....	.....	.....	.....	12.18	12.18
717	6.93	.....	.....	.....	.....	.....	12.08	12.08
....	5.86	.....	.....	.....	.....	.....	12.13	12.13
....	.....	.....	.....	.....	.....	.....	*12.00*	*12.00*
715	12.62	7.15	2.95	.81	10.91	1.91	2.07	16.65
817	12.00	7.07	3.77	1.46	12.30	1.64	2.10	16.66
869	12.97	6.73	2.14	.90	9.77	1.57	2.82	15.40
....	12.53	6 98	2.95	1.06	10.99	1.71	2.33	16.24
....	.....	*6.00*	*1.00*	*.50*	*7.50*	*1.50*	*1.75*	*12.40*
615	11.46	8.41	2.26	.72	11.39	1.73	2.20	16.97
618	11.87	7.79	2.31	.62	10.72	1.56	2.03	15.80
619	11.50	8.27	1.94	.74	10.95	1.88	2.10	16.82
620	11.21	5.06	4.98	.50	10.54	1.47	2.30	15.52
621	12.35	8.31	2.05	.71	11.07	1.64	2.08	16.34
743	11.35	8.19	2.44	.59	11.22	1.59	2.60	16.96
788	12.22	6.56	2.97	.78	10.31	1.76	1.98	15.61
765	11.86	7.48	3.04	1.20	11.72	1.70	2.73	17.21
....	11.73	7.51	2.75	.73	10.99	1.67	2.25	16.41
....	.....	*6.00*	*1.00*	*.50*	*7.50*	*1.50*	*1.75*	*12.40*
714	11.66	7.36	1.55	.90	9.81	1.68	2.44	15.40
870	10.68	6.43	2.32	.90	9.60	1.58	2.29	14.76
....	11.17	6.89	1.93	.90	9.71	1.63	2.37	15.08
....	.....	*6.00*	*2.00*	*.50*	*8.50*	*1.50*	*1.75*	*13.30*
638	4.46	.....	.....	.....	27.70	2.28	.....	22.32
637	5.60	.....	.....	.....	27.26	2.27	.....	22.08
766	4.94	.....	.....	.....	24.85	3.80	.....	24.41
....	5.00	.....	.....	.....	26.60	2.78	.....	22.93
....	.....	.....	.....	.....	*25.00*	*2.25*	.....	*20.63*
705	10.42	6.83	3.23	.64	10.70	1.67	2.26	16.18
711	11.02	8.00	1.78	1.29	11.07	1.69	1.97	15.80

Laboratory No.	Name of Brand and Manufacturer.	Where and From Whom Collected.
806	RED STAR (continued)...	Carr & Carr, McCool.....
868	" "	J. H. Eddleman, Wier's.....
		Average .....
		Guarantee.....
712	VEGETABLE GROWER...	W. S. Howards & Co., Hazleh'st
713	" " ...	Kemp & Abrams, Hazlehurst...
		Average.....
		Guarantee.....
	Goulding Fertilizer Company, Pensacola, Fla.	
	GOULDING'S ACID PHOSPHATE.....	
830		Hawkins & Co., Hattiesburg...
		Guarantee .....
	Jackson Fertilizer Company, Jackson, Miss.	
677	ACID PHOSPHATE.....	W. H. Chambliss, Newton.....
867	" "	N. G. Gilliland & Co., Kosciusko
		Average .....
		Guarantee .....
	COMPLETE VEGETABLE	
630	AND FRUIT.....	Lotterhos&Huber, Crystal Spr's
631	" "	Gallman Mer. Co., Gallman....
809	" "	Robinson Mer. Co., Centerville.
		Average.....
		Guarantee .....
708	GULF STAAES GUANO..	T. C. Simmons & Co., Magnolia.
783	" " " ...	Mayes & Berry, Hazlehurst....
		Average.....
		Guarantee.....
852	KAINIT.....	Lotterhos & Huber, Crystal Sp
		Guarantee .....
	LOTTERHOS & HUBER'S	
768	TOMATO GROWER.....	Lotterhos & Huber, Crystal Sps
		Guarantee .....
625	ROYAL C.....	Lotterhos&Huber, Crystal Spr's
626	"	C. Atkinson, Summit.....
627	"	Gallman Mer. Co., Gallman....
628	"	Earns, Long & Co., Wesson....

Laboratory Number.	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value Per Ton.
		Water Soluble	Citrate Soluble.	Insoluble.	Total.			
806	10.86	7.77	2.63	1.27	11.67	1.60	2.57	16.71
868	12.07	7.06	2.54	.93	10.53	1.55	2.02	15.24
....	11.09	7.42	2.55	1.03	10.99	1.63	2.20	15.98
....	.....	*6.00*	*1.00*	*.50*	*7.50*	*1.50*	*1.75*	*12.40*
712	9.59	5.85	2.35	.78	8.98	2.54	5.93	20.27
713	9.12	5.78	2.33	.63	8.74	2.85	5.86	20.86
....	9.31	5.82	2.34	.70	8.86	2.70	5.89	20.57
....	.....	*5.00*	*2.00*	*.50*	*7.50*	*2.50*	*3.00*	*16.05*
830	7.75	12.88	3.87	4.31	21.06	.....	.....	14.69
....	.....	*13.00*	*2.00*	*1.00*	*16.00*	.....	.....	*13.30*
677	13.05	13.32	3.65	1.11	18.08	.....	.....	14.91
867	10.50	10.98	4.65	.78	16.41	.....	.....	13.60
....	11.72	12.15	4.15	.94	17.24	.....	.....	14.25
....	.....	*12.50*	*2.00*	*1.00*	*15.50*	.....	.....	*12.85*
630	7.61	5.10	1.58	1.20	7.88	3.31	5.76	20.56
631	7.45	5.01	2.55	.50	8.06	3.69	4.61	21.14
809	18.58	4.03	2.87	.40	7.30	3.12	3.95	18.41
....	11.21	4.71	2.34	.70	7.75	3.38	4.77	20.04
....	.....	*3.00*	*3.00*	*1.00*	*7.00*	*3.00*	*4.00*	*17.20*
708	19.86	7.52	2.11	.90	10.53	1.80	1.82	15.74
783	18.98	7.94	1.98	.65	10.57	1.91	2.02	16.53
....	19.42	7.73	2.04	.77	10.55	1.86	1.92	16.14
....	.....	*6.00*	*1.60*	*1.00*	*8.60*	*1.55*	*1.80*	*13.12*
852	4.42	.....	.....	.....	.....	.....	12.17	12.17
....	.....	.....	.....	.....	.....	.....	*10.00*	*10.00*
768	12.21	8.05	2.78	.42	11.25	2.15	2.57	18.50
....	.....	*6.00*	*4.00*	*1.00*	*11.00*	*2.40*	*1.00*	*16.60*
625	19.82	7.71	2.05	.93	10.69	1.82	1.70	15.27
626	17.66	8.05	2.02	.61	10.68	1.89	1.92	16.53
627	17.20	7.52	2.10	.81	10.43	1.99	1.90	16.29
628	19.99	7.51	2.09	.79	10.39	1.73	1.81	15.53

Laboratory No.	Name of Brand and Manufacturer.	Where and From Whom Collected.
629	ROYAC C. (continued)...	J. M. Stephenson, Morton.....
744	"	J. P. Myer, Ellisville.....
784	"	M. D. Graham & Co., Forest...
789	"	Barney Johns & Co., Gloster...
834	"	J. Q. Martin, Hazlehurst.....
		Average .....
		Guarantee.....
	Sold by **Marbach & Eagan,** Crystal Springs, Miss.	
718	BAT GUANO.....	Robinson Mer. Co., Centreville.
719	" "	W. J. Davis, Terry .....
811	" "	J. P. Wise, Hazlehurst.....
883	" "	I. M. Eagan, Crystal Springs..
		Average .....
	P. B. Mathiason Manufacturing Co., St. Louis, Mo.	Guarantee .....
777	VEGETABLE FERTILIZER	J. B. Yellowey, Ridgeland.....
		Guarantee .....
	Meridian Fertilizer Factory, Meridian, Miss.	
696	BLOOD BONE AND B....	Ford Bros. Co., Centreville....
802	" " "	Seward & Gaston, Ackerman..
803	" " "	C. P. McGee, Gloster.....
843	" " "	Bonner Bros., Sandersville....
844	" " "	Weems & Floyd, Shubuta.....
		Average .....
		Guarantee .....
698	FARMERS' FRIEND.....	J. P. Meyer, Ellisville.....
699	" "	Bonner Bros., Sandersville....
		Average .....
		Guarantee .....
851	KAINIT.....	Hawkins & Co., Hattiesburg...
		Guarantee .....
	SOUTHERN ACID PHOS-	
673	PHATE	W. M. McGough, Morton.....
674	" " " ..	W. B. Richardson, Newton....

Laboratory Number.	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value Per Ton.
		Water Soluble	Citrate Soluble.	Insoluble.	Total.			
629	15.31	8.02	2.05	.84	10.91	1.81	1.95	16.35
744	17.96	7.87	2.13	1.05	11.05	1.95	1.79	16.45
784	20.20	7.82	1.84	.72	10.38	1.89	1.96	16.17
789	20.69	7.75	1.96	.73	10.44	1.84	1.75	15.86
834	20.05	7.70	2.07	.67	10.44	1.79	1.85	15.89
....	18.76	7.77	2.03	.79	10.60	1.85	1.85	16.05
....	.....	*6.00*	*1.60*	*1.00*	*8.60*	*1.55*	*1.80*	*13.12*
718	18.80	.....	.....	.....	11.49	4.52	.69	18.88
719	20.08	.....	.....	.....	9.93	4.81	.63	18.62
811	19.34	.....	.....	.....	11.80	4.26	.75	18.48
883	16.41	.....	.....	.....	7.78	4.39	.64	16.28
....	18.65	.....	.....	.....	10.25	4.50	.68	18.07
....	.....	.....	.....	.....	*5.00*	*4.50*	*.75*	*15.00*
777	8.97	2.12	4.19	3.13	9.44	4.21	1.79	18.21
....	.....	*3.50*	*4.50*	*1.50*	*9.50*	*3.75*	*2.00*	*18.93*
696	12.21	7.33	1.72	4.81	13.86	1.98	1.87	15.70
802	14.34	6.86	2.69	4.54	14.09	1.75	1.58	15.24
803	13.51	6.84	2.15	4.18	13.17	2.19	2.59	16.82
843	13.80	6.75	2.30	4.04	13.09	2.10	2.45	16.52
844	16.49	8.26	2.31	2.32	12.91	1.76	2.25	16.99
....	14.07	7.21	2 23	3 98	13.42	1.96	2.15	16.26
.....	.....	*7.75*	*2.00*	*1.00*	*10.75*	*1.75*	*1.85*	*15.78*
698	15.90	9.61	1.97	.77	12.39	1.47	1.58	16.64
699	14.65	10.25	1.99	1.10	13.34	1.38	1.50	16.99
....	15.27	9.93	1.98	.93	12.86	1.43	1.54	16.83
....	.....	*8.00*	*2.50*	*1.00*	*11.50*	*1.25*	*1.50*	*14.88*
851	6.50	.....	.....	.....	.....	.....	12.64	12.64
....	.....	.....	.....	.....	.....	.....	*12.00*	*12.00*
673	15.42	12.74	2.31	1.18	16.23	.....	.....	13.32
674	16.29	14.17	1.04	1.05	16.26	.....	.....	13.58

Laboratory No.	Name of Brand and Manufacturer.	Where and From Whom Collected.
	SOUTHERN ACID PHOSPHATE (continued)	
675	" " " ..	G. W. Walton, Hickory..... ..
795	" " " ..	D. O. Mathews, Iuka.....
858	" " " ..	W. H. Barron & Co., Crystal Spr
859	" " " ..	Donald Bros., Quitman.....
		Average .....
		Guarantee .....
701	SOUTHERN SOLUBLE....	Lampton Mer. Co., Magnolia..
804	" " ..	T, B. Gaddis, Morton.....
855	" " ..	Wm. Atkinson&McDonald, W's'n
		Average .....
	STANDARD HOME MIXTURE	Guarantee .....
616		J. McGrath & Sons, Brookhaven
617	" " "	Earns, Long & Co., Wesson...
622	" " "	T. C. Vivaret & Bro., Newton..
623	" " "	T. F. Abney & Son, Newton...
624	" " "	W. B. Richardson, Newton....
786	" " "	S. J. Johnson. Ellisville.....
790	" " "	J. F. Story, Forest .....
828	" " "	G. K. Evans & Co., Pachuta..
848	" " "	Weems & Floyd, Shubuta .....
		Average .....
	Mobile Phosphate and Chemical Co. Mobile, Ala.	Guarantee .....
726	ECLIPSE SOLUBLE GU'NO	M. J. L. Hoye's Sons, Newton..
812	" " "	J. W. McKay, Waynesboro....
838	" " "	J. M. Stevenson, Morton.....
		Average .....
		Guarantee .....
724	I. X. L. ACID PHOSPHATE	Wm. Atkinson&McDonald, Wesn
725	" " "	T. C. Simmons & Co., Magnolia
800	" " "	Lann & Carter Hdw. Co., Aber.
801	" " "	W. B. Potts Co., Kosciusko...
874	" " "	Miss. & Ala. Co-operative Merc. Co., State Line .....
		Average .....
		Guarantee .....

Laboratory Number.	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Val. Per Ton.
		Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
675	16.34	13.92	1.50	.44	15.86	.....	.....	$13.73
795	13.96	12.74	3.74	.45	16.93	.....	.....	14.46
858	13.20	11.19	5.13	1.78	18.10	.....	.....	14.17
859	12.74	11.91	5.15	1.22	18.28	.....	.....	14.84
....	14.66	12.78	3.14	1.02	16.94	.....	.....	14.02
....	.....	*12.50*	*2.00*	*.50*	*15.00*	.....	.....	*12.85*
701	13.09	7.93	2.01	1.18	11.12	2.12	1.73	16.77
804	14.02	7.64	1.77	2.07	11.48	2.01	1.79	16.05
855	13.57	7.52	2.04	2.44	12.00	2.06	2.09	16.60
....	13.56	7.70	1.94	1.89	11.53	2.06	1.87	16.47
....	.....	*7.75*	*2.00*	*1.00*	*10.75*	*1.75*	*1.85*	*15.78*
616	13.35	7.97	1.86	.85	10.68	2.04	1.84	16.58
617	13.39	8.00	2.13	.68	10.81	1.97	1.87	16.72
622	13.01	7.85	2.20	.77	10.82	1.90	1.99	16.57
623	15.79	7.89	2.10	.88	10.87	1.94	1.89	16.52
624	13.71	8.02	1.86	.80	10.68	1.92	1.92	16.41
786	13.97	7.51	1.98	2.66	12.15	2.15	2.28	16.95
790	13.06	6.79	2.18	2.53	11.50	2.24	1.94	16.29
828	13.01	7.97	2.49	1.89	12.35	2.28	1.83	17.74
848	13.91	8.49	1.53	1.22	11.24	1.76	2.35	16.61
....	13.69	7.83	2.04	1.36	11.23	2.02	1.91	16.71
....	.....	*7.75*	*2.00*	*1.00*	*10.75*	*1.75*	*1.85*	*15.78*
726	13.21	8.19	2.02	1.16	11.36	2.01	2.33	17.36
812	12.44	8.78	1.41	1.94	12.13	2.09	2.49	17.77
838	12.38	6.54	2.65	1.61	10.80	2.21	2.78	17.23
....	12.67	7.83	2.03	1.57	11.43	2.10	2.53	17.45
....	.....	*8.00*	*1.25*	*1.50*	*10.75*	*1.45*	*1.50*	*14.25*
724	12.76	10.91	2.80	1.73	15.44	.....	.....	12.06
725	12.75	10.55	3.37	2.57	16.49	.....	.....	12.20
800	13.92	10.98	2.98	2.60	16.56	.....	.....	12.27
801	14.17	9.85	3.23	3.40	16.48	.....	.....	11.45
874	17.47	8.60	4.14	2.64	15.38	.....	.....	11.05
....	14.21	10.18	3.30	2.59	10.07	.....	.....	11.81
....	.....	*10.00*	*2.00*	*1.50*	*13.50*	.....	.....	*10.60*

Laboratory No.	Name of Brand and Manufacturer.	Where and From Whom Collected.
853	KAINIT	Wetherbee&Huggins, Waynesb
		Guarantee
690	K. K. K. AMMONIA'D BONE	Hawkins & Co., Hattiesburg
691	" " "	J. L. Moyse & Bro., Summit
761	" " "	J. L. Moyse & Bro., Summit
873	" " "	W. V. Thompson, Quitman
		Average
		Guarantee
692	MOBILE STANDARD	W. M. Hyde, Vossburg
723	" "	W. H. Chambliss, Newton
635	" "	Winner & Meyer, Meridian
748	" "	S. M. Barnett, Booneville
781	" "	W. H. Chambliss, Newton
829	" "	J. E. Buckley, Enterprise
872	" "	B. F. Harris, State Line
		Average
		Guarantee
	New Orleans Acid and Fertilizer Co., New Orleans, La.	
	BLACK DIAMOND ACID	
792	PHOSPHATE	W. B. Potts Co., Kosciusko
847	" "	Hattiesburg Comp. Co., Hatties'g
877	" "	Seward & Gaston, Ackerman
		Average
		Guarantee
	CRESCENT CITY ACID	
794	PHOSPHATE	N. Doolittle, Newton
808	" "	J.P.&W.C.Wetherbee, Waynsb'r
		Average
		Guarantee
	GOLD DUST FOR COTTON	
778	AND CORN	Robinson Merc. Co., Centreville
818	" " " "	J. K. Kirkland, Quitman
836	" " " "	Wm. Atkinson-Bacot Co., Osyka
837	" " " "	HattiesburgComp. Co., Hattiesb
		Average
		Guarantee

Laboratory Number	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value per Ton.
		Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
853	5.28	.....	.....	.....	.....	.....	12.34	$12.34
....	.....	.....	.....	.....	.....	.....	*12.00*	*12.00*
690	12.94	8.15	1.72	.95	12.82	1.39	1·54	14.72
691	12.85	7,57	2.24	1.05	10.86	1.39	1.60	14.67
761	13.54	6.95	4.10	2.43	13.48	1.38	1.38	15.47
873	12.03	9.21	3.28	3.71	16.20	1.07	1.04	15.88
....	12·84	7·97	2·83	2·03	12·84	1·31	1·39	15·18
....	.....	*8.75*	*1.25*	*1.50*	*11.50*	*.85*	*1.00*	*13.01*
692	10.97	7.07	2.52	1.40	10.99	2.08	2.34	16.87
723	10.31	6.06	2.56	1.54	10.16	2.11	2.21	15.86
635	12.86	7.80	1.30	.98	10.08	2.03	2.39	16.44
748	10.24	7.66	1.95	1.38	10.99	2.29	2.53	17.67
781	11.74	6.43	2.78	2.39	11.60	1.81	2.41	15.87
829	12.71	7.47	2.13	1.60	11.20	1.82	2.49	16.43
872	15.98	7.71	3.16	1,20	12.07	1.59	1.93	16.46
....	12·11	7·17	2·34	1·49	11·01	1·96	2·33	16·51
....	.....	*6.00*	*2.00*	*1.50*	*9.50*	*1.65*	*2.00*	*13.93*
792	11.81	9.49	4.56	1.00	15·05	.....	.....	12.19
847	12.68	8.58	4,35	1.39	14.32	.....	.....	11.23
877	11.33	8.07	5.40	1.11	14.58	.....	.....	11-58
....	11·94	8·71	4·77	1·16	14,65	.....	.....	11·66
....	.....	*10.00*	*2.00*	*2.00*	*14.00*	.....	.....	*10.60*
794	12.16	8.37	5.64	.96	14.97	.....	.....	12.05
808	11.28	7.60	6.14	1.22	14.96	.....	.....	11.75
....	11·72	7·98	5·89	1·09	14·97	.....	.....	11·90
....	.....	*10.00*	*2.00*	*2.00*	*14.00*	.....	.....	*10.70*
778	10.36	8.52	2.48	1.93	12,93	1.59	1.34	16.07
818	12.03	8.37	2.99	2.09	13.45	1.72	1.42	16.77
836	11.38	7.60	4.21	.92	12.73	2.03	1.52	17.98
837	12.97	7.60	3.58	1.42	12.60	1.67	1.70	16.70
....	11·68	8·02	3·31	1·59	12·93	1·75	1·49	16·88
....	.....	*7.25*	*2.10*	*1.50*	*10.85*	*1.92*	*1.00*	*14.94*

Laboratory No.	Name of Brand and Manufacturer.	Where and From Whom Collected.
	GOLDSMITH'S IMPROVED	
787	MIXTURE.....	L. Cohn & Bro.. Brookhaven..
772	" " "	A. B. Wolf. Forest.....
773	" " "	N. Doolittle, Newton.....
774	" " "	G. W. Walton, Hickory.....
875	" " "	Hawkins & Co., Hattiesburg...
876	" " "	Earns, Long & Co., Wesson....
		Average .....
		Guarantee .....
	Pacific Guano Co., Charleston, S. C..	
746	SOL. PACIFIC GUANO...	Gilmore & May, Amory.....
		Guarantee .....
	Planters' Fertilizer Company, New Orleans, La.	
720	COTTON AND CORN FER.	Boyd & Lee, Wesson.....
810	" " " ..	Boyd & Lee, Wesson.....
		Average .....
		Guarantee .....
	Southern Fertilizer Co., Atlanta, Ga.	
749	SCOTT'S ACID PHOS.....	D. D. Richardson, Columbus...
		Guarantee .....
	SCOTT'S ACID AND MEAL	
756	FORMULA.....	D. D. Richardson, Columbus...
		Guarantee .....
	SCOTT'S GOSSYPIUM	
878	PHOSPHO.....	W. G. Rutledge, Ripley.....
879	" " " ..	A. Roberts & Co., Lauderdale..
		Average .....
		Guarantee .....
	Standard Guano & Chemical Co., New Orleans, La.	
727	ACID PHOSPHATE	Lampton Mer. Co., Magnolia..
728	" "	J. P. Wise, Hazlehurst.....

Laboratory Number.	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value Per Ton.
		Water Soluble	Citrate Soluble.	Insoluble.	Total.			
787	12.12	7.94	3.71	1.32	12.97	1.84	1.52	$17.40
772	12.82	8.57	2.14	2.07	12.78	1.60	1.43	15.93
773	11.37	8.11	2.83	1.47	12.41	1.94	1.53	17.04
774	12.87	8.42	2.08	2.00	12.50	1.71	1.57	16.14
875	12.86	8.31	3.14	1.87	13.32	1.68	1.31	16.65
876	12.47	7.75	3.28	1.45	12.48	1.88	1.54	16.94
....	12.42	8.18	2.86	1.69	12.74	1.77	1.48	16.68
....	.....	*7.25*	*2.10*	*1.50*	*10.85*	*1.92*	*1.00*	*14.94*
746	16.62	7.77	.96	2.07	10.80	1.94	1.21	14.69
....	.....	*6.50*	*2.00*	*2.00*	*10.50*	*1.75*	*1.00*	*13.68*
720	11.82	6.67	1.51	.06	8.24	2.22	1.65	15.23
810	11.66	6.75	1.56	.06	8.37	2.04	2.21	15.46
....	11.74	6.71	1.54	.06	8.31	2.13	1.93	15.35
....	.....	*7.00*	*1.50*	*.15*	*8.65*	*2.00*	*2.00*	*15.35*
749	11.01	9.98	5.10	3 72	18.80	.....	.....	13.06
....	.....	*11.00*	*3.00*	*1.00*	*15.00*	.....	.....	*12.30*
756	11.06	8.21	3.77	3.44	15.42	1.32	1.22	16.12
....	.....	*7.00*	*3.00*	*1.00*	*11.00*	*.83*	*1.00*	*12.78*
878	12.05	7.93	2.20	2.19	12.32	2.83	1.81	18.79
879	11.61	6.97	3.58	2.05	12.60	2.34	2.09	18.13
....	11.83	7.45	2.89	2.12	12.46	2.58	1.95	18.46
....	.....	*6.00*	*3.00*	*1.00*	*10.00*	*2.05*	*2.00*	*15.83*
727	12.43	11.71	5.01	.92	17.64	.....	.....	14.55
728	13.81	10.85	5.51	1.87	18.23	.....	.....	14.17

Laboratory No,	Name of Brand and Manufacturer.	Where and From Whom Collected.
791	ACID PHOSPHATE (con'd)	Seward & Fancher, McCool....
866	" "	T. M. Heidelberg, Heidelberg..
		Average .....
		Guarantee .....
	BLOOD, BONE, AND	
700	MEAT GUANO	Hymon Mer. Co., Summit.....
813	" " "	Hymon Mer. Co., Summit.....
832	" " "	J. L. Strahan, Poplarville.....
		Average .....
		Guarantee .....
	CHAMPION FARMER'S	
706	CHOICE	S. Wolf, Osyka.....
707	" "	Pfeifer & Dreyfus. Brookhaven
845	" "	Sandersville Mer.Co.,Sanders'le
846	" "	T. M. Heidelberg, Heidelberg..
863	" "	B. E. Jacobs, Gloster.....
		Average.....
		Guarantee ... ..
709	GROUND BONE.....	Lotterhos&Huber, Cryst'l Spr's
710	" "	S. Wolf, Osyka.....
767	" "	Hymon Mer. Co., Summit.....
864	" "	I. N. Varnado, Osyka.....
		Average.....
		Guarantee .....
854	KAINIT.....	C. Atkinson, Summit.....
		Guarantee .....
	MISSISSIPPI HOME GU-	
747	ANO.....	Dalrymple,Jonson &Co., Amory
831	" "	B. F. Fridge, Ellisville.....
		Average.....
		Guarantee .....
814	Pelican Raw Bone Guano.	Wm. Atkinson-Bacot Co.,Osyka
		Guarantee .....
	STANDARD AMMONIATED	
785	SOLUBLE GUANO.....	M. J. L. Hoye's Sons, Newton..
		Guarantee .....

Laboratory No.	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Val. Per Ton.
		Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
791	11.85	10.40	6.29	1.80	18.49	.....	.....	14.39
866	12.27	12.29	3.47	2.09	17.85	.....	.....	13.84
....	12.59	11.31	5.07	1.67	18.05	.....	.....	14.23
....	.....	*10.00*	*2.00*	*1.00*	*13.00*	.....	.....	*10.60*
700	11.58	8.25	2.05	1.38	11.68	1.90	2.89	17.74
813	11.27	8.35	2.54	1.89	12.78	2.24	2.46	18.70
832	11.00	6.54	3.41	1.83	11.78	2.48	2.70	18.51
....	11.28	7.71	2.66	1.70	12.08	2.21	2.68	18.32
....	.....	*4.00*	*4.25*	.....	.....	*1.70*	*2.00*	*14.07*
706	10.78	6.84	2.28	1.46	10.58	2.16	1.81	16.10
707	11.65	6.56	2.63	.86	10.05	2.31	2.00	16.70
845	11.27	7.24	1.86	2.16	11.26	1.97	1.55	15.39
846	11.57	7.38	1.95	2.00	11.33	1.71	1.66	15.08
863	11.47	6.63	2.77	1.46	10.86	2.02	1.68	15.85
....	11.35	6.93	2.30	1.59	10.82	2.03	1.74	15.82
....	.....	*4.00*	*4.00*	*1.00*	*9.00*	*1.65*	*1.50*	*13.22*
709	4.02	.....	.....	.....	22.16	3.77	.....	20.50
710	4.52	.....	.....	.....	*19.01*	2.83	.....	*16.58*
767	4.70	.....	.....	.....	*16.51*	2.90	.....	*15.51*
864	4.03	.....	.....	.....	*19.02*	*3.16*	.....	*17.41*
....	4.32	.....	.....	.....	19.17	3.16	.....	17.50
....	.....	.....	.....	.....	*18.50*	*2.50*	.....	*15.50*
854	4.02	.....	.....	.....	.....	.....	*12.24*	*12.24*
....	.....	.....	.....	.....	.....	.....	*12.00*	*12.00*
747	10.53	8.23	2.81	1.41	12.46	2.27	2.54	*18.99*
831	12.21	8.57	2.73	2.61	13.91	2.12	2.59	*18.92*
....	11.37	8.40	2.77	2.01	13.18	2.20	2.57	18.95
....	.....	*4.00*	*5.00*	*1.00*	*10.00*	*1.65*	*2.00*	*14.62*
814	12.28	6.01	3.49	2.06	11.56	*1.99*	*1.20*	*15.33*
....	.....	*4.00*	*4.00*	*1.00*	*9.00*	*1.65*	*1.50*	*13.22*
785	12.32	6.00	2.64	2.96	*11.60*	*1.96*	*1.46*	*14.74*
....	.....	*4.00*	*4.00*	*1.00*	*9.00*	*1.65*	*1.50*	*13.22*

Laboratory No.	Name of Brand and Manufacturer.	Where and From Whom Collected.
	STERN'S AMMONIATED R.	
816	B. SUPERPHOSPHATE..	Daniel & Willoughly, Brookh'vn
632	" " "	C. Atkinson, Summit.....
633	" " "	Hymon Mer. Co., Summit.....
634	" " "	Earns, Long & Co., Wesson...
782	" " "	Wm. Atkinson-Bacot Co..Osyka.
860	" " "	S. Wolf, Osyka.....
861	" " "	Dalrymple, Johnson&Co. Amory
862	" " "	Seward & Fancher, McCool....
865	" " "	F. H. Hartman, Brookhaven...
		Average .....
	Tennessee Chemical Company, Nashville, Tenn.	Guarantee .....
	OX BRAND BONE WITH	
757	AMMONIA AND POTASH	Myers & Egger, Columbus.....
880	" " "	R. M. Bourdeaux, Lauderdale..
		Average.....
	OX BRAND COTTON GU-	Guarantee .....
776	ANO.....	T. J. Bostic & Sons, Meridian..
759	" " "	Myers & Egger, Columbus.....
		Average.....
	OX BRAND HIGH GRADE	Guarantee.....
807	DIS. BONE.....	T. J. Bostic & Son, Meridian...
758	" " "	Myers & Egger, Columbus.....
		Average .....
	Threefoot Bros. & Co., Meridian, Miss.	Guarantee.....
721	HIGH GRADE ENGLISH	J. L. Wells, Hickory.....
841	ACID PHOSPHATE.....	Threefoot Bros.&Co., Meridian.
857	" " " ..	E.P.&B. R. Brown, Lockhart...
		Average.....
		Guarantee.....
722	THREEFOOT'S IMPROVED	J. L. Wells, Hickory.....
805	MIXTURE.....	Threefoot Bros. & Co., Meridian
856	" " ..	E. P. & B. R. Brown, Lockhart..
		Average .....
		Guarantee .....

Laboratory Number	Moisture—Per Cent.	Phosphoric Acid—Per Cent.				Nitrogen—Per Cent.	Potash—Per Cent.	Relative Value per Ton.
		Water Soluble.	Citrate Soluble.	Insoluble.	Total.			
816	12.48	6.73	3.12	1.88	11.73	2.17	1.34	$16.30
632	12.74	7.42	1.94	1.80	11.16	1.73	1.64	15.13
633	13.78	7.46	2.29	1.15	10.90	1.76	1.45	15.37
634	13.25	7.27	3.07	.62	10.96	1.73	1.31	15.67
782	13.09	6.36	3.05	2.09	11.50	2.30	1.41	16.27
860	12.73	5.80	2.80	2.12	10.72	1.98	1.73	15.00
861	12.99	7 25	1.51	1.45	10.21	1.57	1.48	14.01
862	12.16	6.37	3.23	2.55	12.15	2.14	1.37	16.00
865	12.71	5 92	2.60	2.23	10 75	1.78	1.17	13.88
....	12.88	6.73	2.62	1.76	11.12	1.91	1.43	15.29
....	.....	*4.00*	*4.00*	*1.00*	*9.00*	*1.65*	*1.50*	*13.22*
757	10.28	8.46	3.54	1.60	13.60	1.13	1.34	15.81
880	9.36	7.54	4.66	2.55	14.75	.91	.98	14.99
....	9 82	8.00	4.10	2.07	14.17	1.02	1.16	15.40
....	.....	*8.00*	*2.00*	*1.00*	*11.00*	*.82*	*1.00*	*12.82*
776	9.53	7.84	3.28	1.55	12.67	1.64	1.19	16.02
759	9.36	8.06	5.57	.37	14.00	1.57	1.13	18.13
....	9.44	7.95	4 42	.96	13.33	1.61	1.16	17 08
....	.....	*8.00*	*2.00*	*1.00*	*11.00*	*1.65*	*1.00*	*14.93*
807	12.12	13.65	2.65	.77	17.07	.....	.....	14.-1
758	11.12	11,07	3.14	1.13	15·34	.....	.....	12.48
....	11.62	12.36	2 89	.95	16.20	.....	.....	13.45
....	.....	*11.00*	*3.00*	*1.00*	*15.00*	.....	.....	*12.30*
721	15.04	11.51	4.08	.73	16.32	.....	.....	13.62
841	14.98	12.09	4.54	1.01	17.64	.....	.....	14.51
857	16.74	13.93	2.51	1.24	17.68	.....	.....	14.54
....	15.58	12.51	3.71	.99	17.21	.....	.....	14 22
....	.....	*12.50*	*2.50*	.....	.....	.....	.....	*13 25*
722	10.82	8.19	2.73	.74	11.66	2.03	2.16	17.88
805	13.52	7.11	2.00	2.25	11.36	2.31	2.77	17.45
856	13.92	6.82	1.90	2.39	11.11	1.93	2.03	15.38
....	12.75	7.37	2.21	1.79	11 37	2.09	2 32	16.90
....	.....	*8.00*	*2.00*	.....	.....	*1.77*	*1.90*	*16.13*

ANALYSES

—OF—

FERTILIZERS

ON SALE IN MISSISSIPPI.

Fifth Monthly Edition, Including all Analyses for Season 1897-'98.

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MISSISSIPPI

Agricultural and Mechanical College

EXPERIMENT STATION.

Bulletin No. 50.

Winter and Summer Pasture in Mississippi.

E. R. LLOYD.

AGRICULTURAL COLLEGE, MISS.,
SEPTEMBER, 1898.

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Winter and Summer Pastures

IN MISSISSIPPI.

E. R. LLOYD.

Introduction.

The keeping of live stock is an important feature in the economics of farming. In this practice, whether the stock consists of dairy animals, young stock, sheep or hogs, the importance of a full supply of food, in order to maintain a continuous growth, is recognized. Stock raising in a farming country is not profitable unless they can be grown on cheap feed and with a minimum amount of labor, and the only way in which to accomplish this is to supply an abundance of good pasture.

In all prosperous farming countries the rearing and keeping of live stock is considered essential in maintaining the fertility of the soil; and this problem of a permanent pasture must be settled before the farmer can raise stock economically.

Preparation of the Soil.

In making a permanent pasture, the first thing to be done is to thoroughly prepare the land by deep plowing and harrowing. No grass will furnish a maximum amount of pasturage on a poor exhausted soil, and fertilizers are as necessary and as profitable for a pasture as elsewhere. Cotton seed, 800 pounds; stable manure, 800 pounds, and kainit, 400

pounds, made into a compost and applied at the rate of one ton per acre broadcast, and plowed under, will give very satisfactory results; or, if more convenient to use commercial fertilizers, cotton-seed meal, 500 pounds, kainit, 300 pounds, and gypsum or slaked lime, 200 pounds, applied at the rate of 1,000 pounds per acre broadcast, after the land has been broken, and then well worked into the soil with a harrow just before the seed are to be sown. It is seldom necessary to use phosphoric acid on soils that contain even a small per cent. of lime, but in the piney woods region or on any sandy loam soil an application of phosphoric acid will be necessary and will give excellent results; so in the sandy soils of the State, I would substitute for the 300 pounds of kainit, in previous formula, 300 pounds of phosphoric acid.

In preparing a permanent pasture, the land should be plowed some time before the seeding is to be done, and since a pasture is expected to last for a number of years with no further cultivation, the soil should be loosened at as great a depth as practicable, to allow a free circulation of air and water and to allow the roots of plants to penetrate deeper into the soil; whereby the dangers of winter killing and being pulled out by stock are greatly lessened. The time and extra expense of thoroughly sub-soiling the land would be well spent. After the land has been deeply and closely broken, go over the field with a disc harrow in two directions, so that no hard, unbroken places will be left. Follow the disc with a light, stright-tooth harrow so there will be left a uniform level surface with a finely pulverized seed bed.

There is a large area in the State where the use of the disc harrow may not be necessary. This is especially true of the sandy soils in the southern part of the State. Wherever the soil is of a loose, open texture and crumbles readily when plowed, it is not necessary to use the disc harrow; a light smoothing harrow is all that is needed on such soils, and as a rule it would not pay to sub-soil this character of land, as the soil is always open enough.

Bermuda Grass. (*Cynodon Dactyland.*)

This grass is unquestionably the best pasture grass for the South, and is one of the most nutritious pasture grasses grown in the Southern States. While it requires a rich soil for its best development, it will grow well and furnish a large amount of grazing on the thinnest soil.

After a good sod has been formed it is practically impossible for the land to wash; Bermuda has no equal as a soil holder. All kinds of stock are equally fond of it. I have seen both horses and cattle leave a good red clover field and graze Bermuda on ditch banks and along road-rides. Bermuda is adapted to all kinds of soil. You will find it growing well on the sandy soil of the piny woods, and on the red clay hills and on the black lands of the prairie belt.

Since Bermuda grass very rarely, if ever, matures seed in this latitude, the only safe method to propagate it is by transplanting the roots or the underground stems. This should be done in March.

After the land has been prepared as recommended above, then with a bull-tongue or narrow shovel plow open rows two feet apart. With a short spade shave off sod two inches thick; or, a cheaper and quicker method would be take a two-horse turning plow and set it to run shallow, and turn or edge up the sod. The sod can then be hauled in large pieces to the field and there be broken or cut into small pieces and dropped in the drill two feet apart, and covered with a light harrow; or, a better plan would be to go over the field with a heavy roller. This would firm the loose soil around the sod and at the same time level or press down the ridges left by the plow. If the pieces of sod are entirely covered there will be no harm done; as soon as there is moisture enough in the soil the roots will take hold and the grass make rapid growth. In this climate Bermuda will furnish excellent grazing from the middle of May until the middle of November, and often as late as the middle of December. To obtain

the best and largest amount of grazing the Bermuda pasture should be plowed and harrowed in the spring once in from three to five years.

Carpet Grass. (*Paspalum platycaule.*)

On the sandy soils in the southern part of the State this grass is preferred of all grasses for pasture. It makes its best growth in the moist sandy valleys, and shoots up with the first warm days of Spring, and furnishes excellent pasture nearly the entire year and is not injured by frost and will stand more hard trampling and close grazing than any grass we have in the sandy region. It thoroughly covers the ground, forming a thick, tender turf, and is eaten with great relish by all kinds of stock. This grass thrives best where it is trampled. The trampling seems to be essential to its successful growth, and like Bermuda, roots at every joint; but, unlike Bermuda, it is no trouble to get rid of this grass by cultivation, but as soon as the land is turned back to pasture it soon makes its appearance and furnishes good grazing in a short time. Carpet grass can be introduced into new fields as directed for Bermuda or by sowing the seed. This grass also does equally as well on the brown and yellow loam soils in the western part of the State. Lespedeza growing on the same land, which is often the case, adds to the value of the pasture.

Lespedeza, or Japan Clover. (*Lespedeza striata.*)

This plant, it is claimed, was introduced into this country from Japan, and was first noticed in South Carolina, but is now perfectly at home all over the South, and as far west as Texas and north to the Ohio river. Lespedeza is rather slow to start in spring, making little growth before June, but after that time grows very rapily, and even on very poor land will furnish excellent

grazing from July 1st until frost. While it is an annual, it will perpetuate itself without care, and like most other members of the clover family, does best on a lime soil, but will do well on the red clay hills and sandy soils of the State.

After Lespedeza has gotten a start on poor land, and if not too closely grazed the first year, will in a short time crowd out the weeds and other worthless plants; and while its growth on poor land will be low and spreading, it will be thick and high enough to furnish good grazing.

In seeding land to Lespedeza, one-half bushel of seed to the acre is ample. The seed can be sown as early in the spring as the danger of frost has passed; or, if preferred, the seed can be sown on oat land in the fall.

After sowing the seed, go over the land with a light smoothing harrow, and it would be much better if the land could be rolled.

Melilotus. (*Melilotus alba.*)

This plant closely resembles Alfalfa, but makes a much larger and coarser growth, and is especially adapted to lime soils. It will make a good growth on any lime soil, even on the white barren lime hills, where the land is so poor that no other plant will live. Melilotus is of little or no value on the red clay or sandy soils which contain little lime. In this latitude it is a biennial plant, making only a moderate growth the first year, but an excellent growth the second. This plant comes from seed the first year and from roots the second, and will then continue to re-seed itself for years without interference. The seed may be sown late in August or in February, at the rate of one-half bu. per acre, as directed for Lespedeza.

Melilotus, in either the cured or green state, is not generally liked by animals unaccustomed to it at first, but they soon learn to relish it, and it is very nutritious either in the green or cured state. Melilotus starts into growth early in the spring when other green forage is scarce,

and stock learn to like it very quickly. This plant not only furnishes a large amount of grazing, but has few equals as a soil improver.

Hairy Vetch. (*Vicea villosa.*)

This plant is an annual, and is similar in growth to a slender peavine, the vines often reaching ten to twelve feet in length and completely covering the ground with a dense mat of forage two or three feet deep. The seed should be sown in August or September, at a rate of one bushel per acre, and with the first rains in autumn the seed will germinate, and in favorable seasons the plants will cover the ground by January and then furnish good grazing until the first of May. If the stock are taken off the field by the first of April the plants will mature seed and re-seed the land perfectly for the next season. We have several fields on the Station farm that were seeded to vetch five years ago, and from these fields we have gathered good crops of seed annually, and while we have sown no seed on the land since the first seeding there has been enough seed wasted or shattered during harvest each year to perfectly seed the land. The stand is now perfect.

Vetch ripens its seed early in June, and each year, as soon as the seed have been gathered, the land is broken with a two-horse plow and sown to cow-peas or German millet to be mowed for hay in the fall. These second crops do not in the least injure the stand of vetch. We have never failed to secure a perfect stand of vetch after the hay crop was removed. This plant is relished by all kinds of stock and will stand a great amount of close grazing.

Turf, or Winter Oats.

This oat, sown in August or September, will furnish excellent grazing from November until the middle of May. If a crop of seed is desired, the stock should be taken off the land the first of April. The seed should be sown at the rate of two bush-

els per acre. After the plants have become well rooted they will withstand the hardest freezes we ever have. In 1895, out of several varieties of oats sown the previous fall, all were completely killed by the severe freeze in March, except the Turf oat. On this plant the leaves were killed back about four inches, the plant being otherwise uninjured, and in a few weeks was perfectly green again.

This oat sends up a large number of stems from a single root; often one turf will contain from forty to fifty stems, all of which will have full, heavy heads when ripe.

Redtop (*Agrostis alba.*)

This grass has done well in permanent pastures on all soils containing a good supply of moisture; in fact, it grows well on land too wet to be cultivated in field crops. It makes its best growth on bottom land, but succeeds well on the seepy hills. The seed should be sown early in the spring at the rate of twenty-five pounds per acre, and covered with a light harrow and rolled. The growth the first year will be weak and disappointing, but the second year the plants will make a strong and vigorous growth and furnish excellent grazing through the winter and the greater part of the summer. After the first season redtop will hold its own with other grasses and weeds. Stock of all kinds eat it greedily.

Alsike clover (*Trifolium hybridum.*)

This plant does best on low, rich land, and will make good growth on land that is too wet and seepy for the successful growth of any of the other clovers. It stands close grazing and will, on suitable land, furnish a large amount of excellent pasturage. This plant has also given good results on seepy hillsides and is not injured by cold. The seed should be sown in

August or February at the rate of twelve pounds per acre. The seed should be covered with a light harrow or simply rolled with a heavy roller. Alsike will furnish good grazing nearly the entire winter and until late in the summer, and will hold the ground for years without re-seeding.

Orchard Grass. (*Dactylis glomerata.*)

This grass will make a good growth on wet, heavy soils during winter and furnish good grazing during the fall and winter. Orchard grass has the advantage of making good growth in partially shaded places. This fact being appreciated, makes this grass very popular for sowing in groves or woods lots. It grows in turfs, but by close grazing and thick seeding the grass will very nearly cover the ground. It is liked by stock, and after becoming well established in the pasture, will furnish a large amount of good grazing. It is a perennial which commences its growth with the first warm days in February. It bears grazing well and comes again quickly when cropped down. The seed should be sown in August, or very early in the spring, at rate of forty pounds per acre and either rolled or covered with light harrow.

A Combination Desirable.

With the proper combination of some two or more of the pasture plants just described, it is not only possible, but an easy matter, for every farmer in the State to have for his stock good green pastures the entire year. It matters not in what part of the State his farm is located, whether in the sandy region, the brown loam region, or the prairie region, some suitable combination can be made that will be adapted to his soil conditions.

Pasture Plants for the Pine Woods Soils.

Carpet grass and Lespedeza for the sandy valleys and Hungarian brome grass (*Bromus inermis*), Crab grass and Mexican clover for the upland, will furnish grazing through the summer and late fall, and Turf oats and Hairy vetch sown the latter part of August, will furnish excellent grazing through the winter and early spring. On wet or seepy land Redtop and Alsike clover, sown together, will furnish good pasturage the greater part of the year.

Pasture Plants for the Yellow and Brown Loam.

For summer and fall pastures, Bermuda grass, Carpet grass, Lespedeza, and Orchard grass. On wet or low land, Alsike clover and Redtop. For winter and early spring grazing, Turf oats and Hairy vetch.

Pasture Plants for the Prairie Soils.

For summer and fall grazing, use Melilotus, Lespedeza, Bermuda and Orchard grass. On the wet, low lands, plant Alsike clover and Redtop. For winter and early spring grazing, plant Turf oats and Hairy vetch.

Water Supply.

No pasture is complete without a sufficient supply of good, clean water. Impure water supplied to dairy cows will affect the quality of the milk indirectly by injuring the health of the cows. In a large portion of the State the farmers and stockmen are dependent entirely upon ponds for their supply of water for stock. The pond should be so located that it will be impossible for drainage water from stables, barnyards, or any other

contaminated source to empty into it. Stock should not be allowed to wade in the water, where they not only stir up the mud and filth at the bottom, but void both solid and liquid excrement into the water. If this is allowed, the water soon becomes thoroughly contaminated with filth, and poisonous germs and is unfit and unhealthy for stock to drink. The pond should have a fence around it that would turn all kinds of stock, and a pipe put through the dam and fitted into a nice trough with an automatic float valve, so arranged that as the stock would lower the water in the trough by drinking more would run in, and by this method the trough would never be dry.